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The International Journal of Orthodontia Oral Surgery and Radiography

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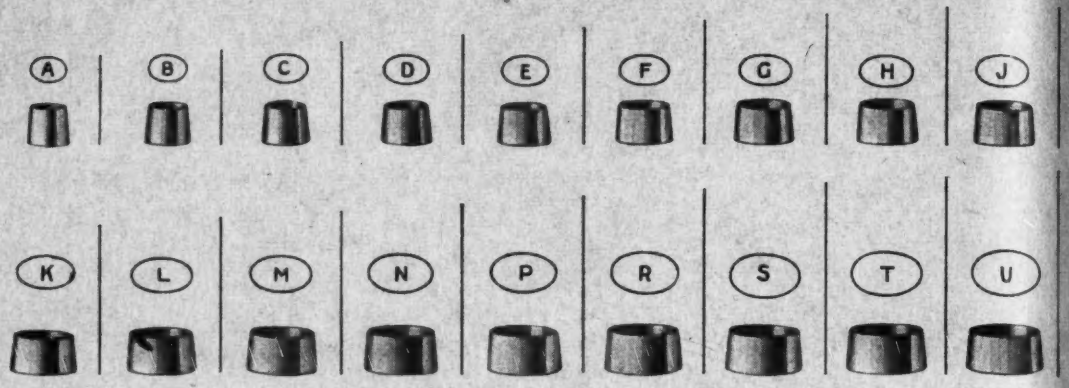

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VOL. XVI ST. LOUIS, MAY, 1930 No. 5

ORIGINAL ARTICLES

BALANCED OCCLUSION IN RELATION TO NATURAL TEETH*

BY R. OTTOLENGUI, M.D.S., D.D.S., NEW YORK, N. Y.

MAN is frequently a creature of impulse, and it is through reacting to an impulse that I find myself here today. Because of my long affection and esteem for Dr. Hawley, and likewise for the members of his executive committee, when I was called to the telephone and asked to contribute a paper on the subject of balanced occlusion, without further stimulus than the high regard that I had for these men and for this society, I at once answered in the affirmative. And now has come the day of reckoning. The promise must be kept.

But, gentlemen, I find that I have little that is new to add to what I have already written on this subject. Therefore, I can only expand my views a little as already published, and it seems necessary, with your kind permission, to begin this paper by quoting an editorial which was entitled "Afunctional Occlusion."

"AFUNCTIONAL OCCLUSION

"The chief object of this editorial is to enter a protest against any continued use of the term 'balanced occlusion,' in connection with natural teeth. We are gradually getting into the same deep waters as those that have so long engulfed us in connection with the terms 'articulation' and 'occlusion.' Articulation, as has been convincingly shown, is a term properly applicable to artificial denture construction. Artificial teeth may be so articulated as to have occlusion when in use, but the natural tooth can have no articulation, save that between the tooth root and its socket. Similarly, artificial dentures may, and indeed must be so articulated as to have a balanced occlusion when in use, because otherwise the dentures, one or both, will be

*Read before the New York Society of Orthodontists, October 14, 1929.

upset. Natural teeth cannot be 'upset,' and hence the term 'balanced,' has no application.

"ORIGIN OF BALANCED OCCLUSION

"The term 'balanced occlusion,' so far as the writer has been able to discover, first occurs in the *American Textbook of Prosthetic Dentistry,* and refers to 'balancing the plate.' It was apparently intended that this term should refer to that type of articulation of artificial teeth which produces 'three point contact.' It is important in this connection to note two facts: First, that the word 'balance' has reference to the plate rather than to teeth; but the balance of the plate must be attained and maintained through the proper arrangement of the teeth, and during mastication, hence the term 'balanced occlusion,' a balance of the plate during masticatory occlusion of the teeth. Second, the term is applicable to full dentures, and not to partial dentures. Partial dentures are kept in 'balance' by clasps or other mechanical attachments, rather than by tooth arrangement.

"How has it happened that 'balanced occlusion' has come into vogue as descriptive of natural teeth? Probably somewhat as follows: The full denture prosthodontist has discovered that 'balanced occlusion,' is essential to the retention and utility of his full denture. The same man, when constructing partial dentures, has found it difficult at times to produce the best efficiency with his artificial denture, because of the 'disarrangement' of the remaining natural organs, and, recalling the plan successfully adopted with his full dentures, he has proceeded to mount casts of the patient's arches upon so-called anatomical articulators, and by them has planned alterations in the natural teeth, in conformity with his rules for balanced occlusion with full denture prosthesis. This he called 'balancing the occlusion,' oblivious of the fact that the word 'balance' in his full denture work alluded to his plate and not to the teeth which they carried. One cannot 'upset' a single tooth on a full artificial denture, any more than he can 'upset' one or more of the natural organs.

"The following definition of 'balanced occlusion' is found in so many papers written by full denture prosthodontists, that it may be considered standard.[1, 2, 3] It reads:

"DEFINITIONS OF BALANCED OCCLUSION

" 'Balanced occlusions are contact positions of masticatory surfaces having contact points so distributed that the forces simultaneously applied to these points of the denture will maintain equilibrium.'

"The above evidently applies only to artificial dentures, as natural teeth are never in danger of losing equilibrium.

"Then we find Dr. Vernon D. Irwin applying the term 'balanced occlusion' to natural teeth.[4]

"Speaking of certain casts of natural teeth he says that they are in 'balanced occlusion,' and defines the term as follows:

" 'The type of relationship between mandible and maxilla (the relationship being maintained through the teeth) which permits maximum continu-

ous contact of the upper occluding surfaces, through all ranges, from central to lateral and incisal, and back to central.'

"This definition is in quotation marks, but the original authority is not cited.

"It is very evident, however, that Dr. Irwin here describes for natural teeth, exactly that occlusal relation which produces 'equilibrium,' or 'balanced occlusion,' in the construction of full artificial dentures.

"But the fact is, that 'maximum continuous contact of the upper occlusal surfaces, etc.,' does not occur in normal natural dentitions.

"Rudolf Hanau, in his studies of occlusion, entirely upon his engineering knowledge, formulated the postulate that such maximum continuous contact should not and does not occur in nature. He presented his views to Dr. J. Lowe Young, and together they then examined a large number of casts of normal, or nearly normal, dentures, and much to Dr. Young's surprise, it was demonstrated that there is always a lack of contact between the second and third, upper and lower molars. This appears to be true in all types, from those having the typical curve of Spee, to others with practically flat occlusal planes. The first molars act as pivotal points upon which the casts can be rocked. Not realizing the extreme inapplicability of the term, partial denture prosthodontists have found it convenient to describe natural arches from which some teeth have been extracted, as being 'out of balance.' Hence they speak of 'unbalanced occlusions,' and of 'balancing the occlusion,' prior to the insertion of a partial denture, or bridge.

"Referring back to the origin of the term 'balanced occlusion,' we would at once see than an 'unbalanced occlusion,' would be one in which the artificial plate is 'tripped up' or 'upset,' during mastication. This is never true of natural teeth, because, regardless of the extent of the 'disarrangement' of his teeth, the patient usually finds a means of masticating so long as he has 'two teeth that hit,' as the old lady of the story proudly boasted.

"It is evident that we need terms to replace 'balanced occlusion,' and 'unbalanced occlusion'; terms that can be used to describe natural teeth.

"FUNCTIONAL OCCLUSION

"In place of balanced occlusion the present writer has already (Louisville meeting of A. D. A., Sept. 24, 1925[5]) suggested the term 'functional occlusion,' which may be defined as follows:

" 'Such arrangement of the teeth as will provide the highest efficiency during all the excursions of the mandible which are necessary to the function of mastication.'

"Functional occlusion differs from normal occlusion in that the latter is the ideal of the occlusion found in the type of man to which the individual may belong whereas functional occlusion applies only to the individual and his individual teeth. Thus functional occlusion, in some instances, may be the equivalent of normal occlusion, whereas in others, it might be very far from the normal ideal. It has the advantage in being a condition always more or less obtainable, and this statement applies in orthodontia, in prosthodontia (full and partial denture construction), and in periodontia.

"AFUNCTIONAL OCCLUSION

"As a substitute for the bastard term 'unbalanced occlusion,' when speaking of natural teeth, the writer ventures to suggest the term 'afunctional occlusion,' being well aware of its demerits, as well as of its merits.

"Afunctional occlusion may be thus defined:

" 'Such malrelation, malformation, malposition or pathologic condition of the teeth as would interfere with function during mastication.'

"A treatise of considerable length could be written upon these two terms, 'functional' and 'afunctional occlusion,' but this is evidently not the place for it. Perhaps, if need arises, a more analytic discussion of the topic may be presented at some later date.

"Suffice it now to outline a few examples of afunctional occlusion, in order to clarify the meaning and uses of the term. 'Afunction' is defined as, 'A lack of function or the power to act.' Hence afunctional must apply to any interference in function.

"Following the language of the definition: Malrelationship—example; Bicuspids that have erupted or drifted into end to end occlusion are in afunctional occlusion. Malformation—example; Teeth with enamel so imperfect that the cusp formation is incomplete, are afunctional. Malposition—example; Teeth which have drifted from their original position, and have become tipped or rotated; teeth which erupt beyond normal height, or which do not reach full normal eruption, are afunctional. Pathologic conditions interfering with correct occlusal contact—example; Teeth that have lost part of their occlusal surfaces by attrition or by caries, and teeth which have lost some of their supporting soft and hard tissues because of periodontoclasia, so that they present an imperfect occlusal antagonism, are in afunctional occlusion.

"It is manifest that where the remaining teeth are in afunctional occlusion, this afunction should be corrected, in so far as possible, before attempting to supply a functional occlusion, using artificial teeth in correlation with natural teeth."

Those who are interested in my views on this topic, if any there be, are referred to the original communication, which was not an original paper but a prepared discussion of an essay by Dr. Harvey Stallard, entitled Functions of the Occlusal Surfaces of Teeth.[6]

Dr. Stallard's paper is especially commended to those periodontists who appear to believe that all the ills that teeth are heir to may be cured or prevented by grinding the natural teeth.

Having already quoted entirely one of my papers, I cannot similarly treat another, yet I believe that I may refer to certain points made therein, and further discuss them.

At that time I described functional occlusion almost as a static, by which I mean unvariable, condition. "The highest efficiency during all the excursions of the mandible which are necessary to the function of mastication."

Let me pause here and endeavor to render it possible for you to visualize this. I have elsewhere declared and still believe that, "given a particular set of teeth, there is but one arrangement of them that will result in functional oc-

clusion. There is but one position into which each tooth must be placed; there is but one relation of direction which each tooth must bear to its socket, and there is but one occlusal relation that each tooth must have with its antagonists that will result in functional occlusion."

Just what did I mean by these words? If we could have a so-called anatomical articulator, with which the movements of the mandible could be exactly recorded and reproduced, then if accurate casts of the mouth of a patient suffering from malocclusion were set up in such an instrument, we might carefully remove all the teeth for a study that will now be outlined. To accomplish this, should anyone desire to try the experiment, it is suggested that the teeth themselves should be of metal, perhaps of amalgam. In removing these metallic teeth from the plaster casts it would be best to pass a fine saw through the interproximal spaces near the gum margin, and to saw up to but not entirely through the contact points. The saw could then be carried along the gum margins until the entire set of teeth could be removed; after which they could be carefully broken apart, thus preserving their mesiodistal width.

With these teeth in hand as separate units, and with the casts so mounted that we have an accurate record of jaw relations, my contention is that there is but one position, and one direction into which each tooth may be placed to attain "the highest efficiency," etc., which I have set up as the standard for functional occlusion. Probably no possible effort of the orthodontist could attain this result in a large majority of cases. *But it is a valuable pattern to serve as a guide in our work.*

Nevertheless there is no denying that entirely satisfactory results may be obtained without reaching this exacting ideal.

Recognizing this fact, I further said (continuing the above quotation): "Any departure from such posing of the teeth, even the slightest, will interfere with functional occlusion. The result may be in a sense an adequate occlusion, but nevertheless it will not be a functional occlusion; it will be functional occlusion, plus or minus."

At this time I have no desire to withdraw the above-mentioned statement, but for all practical purposes it may be modified. We must still maintain the high ideal of functional occlusion outlined, as the pattern toward which we must attune our endeavors. At the same time it is to be remembered that life and health are not dependent upon absolutely perfect functioning of all the organs. So far as mastication is concerned man does not require the thirty-two teeth with which nature has endowed him. In a vast number of cases, the individual would never miss his four third molars, if the other teeth were in functional occlusion. Also in those rare instances where the patient has four molars on each side, either above or below, no distress has been caused. In one instance we have an example of function minus, and in the other function plus.

It is obvious then, that practically speaking, while remembering that in the strictest sense, functional occlusion involves the highest efficiency, etc., still there is a reasonable variation from this that will give us a satisfactory functioning, through an "adequate" occlusion.

Let us now endeavor to comprehend this better with a mathematic equation. Let X represent functional occlusion.

But we also have function plus, and function minus. Let Y represent the extreme aberration from strict functional occlusion that may be endured without serious impairment of the patient's well-being.

Then $X + Y$ would represent one extreme of aberration that may be tolerated, and $X - Y$ the opposite extreme. For practical purposes then we may say that the region between $X + Y$ and $X - Y$ would represent the area of adequate occlusion, and we might well modify the meaning of functional occlusion to include this extent of variation from the ideal.

Then let Z represent the point of variation beyond which functional occlusion would be too greatly disturbed. Then $X + Z$ and $X - Z$ would be the boundaries of that region which is covered by my proposed term "afunctional occlusion."

And this brings us to a consideration of "afunctional occlusion" as a term to replace "balanced occlusion."

When we talk of normal occlusion, or of functional occlusion, I fear that we are prone to think of teeth of full form. But as age advances the occlusal surfaces of the teeth are altered by attrition, and the closure of the jaws also changes; nevertheless, in spite of these changes we see men and women live to ripe old age, and even die by simply "going to sleep" rather than as a result of disease. It follows then what whereas the gradual wear of the teeth destroys the subject's normal occlusion, even supposing that he ever had it, it does not necessarily deprive him of a functional occlusion. And herein lies the value of the term.

Once more quoting from the Louisville discussion, I said: "Normal occlusion necessarily means a type of occlusion, that, within certain variations, is theoretically common, or possible with all races of man. Functional occlusion on the contrary is a condition limited to an individual, and is never duplicated in any other individual."

Similarly it follows that functional occlusion in the individual will necessarily change with advancing years and continued loss of tooth substance.

The orthodontist, therefore, mainly occupied with youth, must ever have in mind the picture of functional occlusion for that particular patient, with his particular teeth, in the normal forms in which they are present.

The dentist and the periodontist, however, must fully comprehend what functional occlusion means in mouths at all ages, and with teeth in all conditions of wear. They both must comprehend afunctional occlusion and treat it when met. Malformations and malposed teeth, representing function minus, one extreme of afunctional occlusion, should be restored to the positions and forms, which they might have, had they been in correct position when erupted and had they suffered the same destruction as a similar tooth on the opposite side, for example. Inlays which restore the original contours of such teeth are not indicated.

Teeth which from lack of use and consequent lack of attritional wear, or which for any cause rise beyond the occlusal plane, represent functional occlusion plus, or traumatic occlusion, one type of afunctional occlusion.

These afunctional occlusions should be corrected, but it is never needful to build up and to grind down such teeth, until they act and react as do artificial dentures; until they are brought to "that relationship between mandible and maxillae which permits maximum continuous contact of the upper occluding surfaces, through all ranges, from central to lateral and incisal, and back to central."

Teeth so formed simulate the balanced occlusion necessary for the retention and use of artificial dentures, where there are but two units of mastication, the upper plate and the lower plate. But such grinding of natural teeth not only is not needful, but is never desirable. Functional occlusion in all the excursions of the mandible essential to mastication is not attainable by such treatment, which practically always destroys masticating efficiency by alteration of occlusal form, as well as by causing erroneous contacts, because in natural dentures there never should be "maximum continuous contact of the upper occluding surfaces, etc." This we are told is a balanced occlusion, and if so neither the term nor the treatment should ever be applied to the natural organs.

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DISCUSSION

Dr. Harvey Stallard.—I have already taken up so much time that I hesitate to speak again, but Dr. Ottolengui read this paper at Louisville where I criticized it, perhaps unfairly, and I rather wish to apologize for any seemingly discourteous remarks I may have made then. However, I fear I may speak even worse now, because I am not speaking from the written page.

I may say that I was delighted at the reception Dr. Ottolengui gave in a recent round table talk to my adopted pet, gnathology. I read his criticism to a friend who does the laboratory work for a gnathologist. My friend said when I had finished, "That guy who wrote that does not know the first thing about gnathologic work. He does not mention how important it is to determine the credit rating of the patient. That is the first thing to be done."

Dr. Ottolengui.—I suspected that but I did not want to say it.

Dr. Stallard.—By this levity, I do not mean to discredit gnathologic fees, because they are really earned fees. The mouth is worth the effort. I might say that I have encouraged the Gnathologic Society to break new ground, because dentistry, as now practiced everywhere, is largely a matter of filling holes in teeth. You can take your own orthodontic casts and see what dentistry is. Go home and look at them! I do not care from what office your patients come, you will find that the greatest abnormalities of tooth forms are in those parts restored by dentists. These things are abnormal not only in contacts, contours, and occlusal anatomy, but also in occlusal relations.

I have the honor to pay Dr. Young a very great vote of thanks. It was he who first insisted that all of the supplementary ridges should be reproduced in dental restorations. Instead of making a child wear an inlay for an old, worn tooth, cut down the fossa of the inlay so that it actually reproduces the youthful aspect of the tooth. Instead of treating a cusp as if it has four planes, treat it as having a triangular ridge, a central ridge, and two marginal ridges (mesial and distal) and then place on both sides of that cusp miniature

cusplets which have identically the same types of ridges. Instead of making teeth flat by filling up the occlusal fossa with gold foil, take inlays and reproduce the actual occlusal surfaces and ridges.

This is being accomplished by several operators on the Pacific Coast, and their procedures are somewhat like that deprecated by Dr. Ottolengui in his editorial.

It would bore you to go too much into details on their procedures. However, we have not quite adopted the term functional or afunctional occlusion. We speak of coordination of cusps, by which we mean that the cusps of the mandible must coordinate ridge by ridge with the maxillary teeth, and in order to do that they must coordinate properly with the movements of the mandible.

Furthermore, we are getting further away from speaking of cusp occlusion. We speak of normal "ridge relations." The purpose of teeth is to chew food. That is their principal use. Such, strange to say, is not a function of teeth. Chewing is, strictly speaking, not a function of teeth, but a use of teeth accomplished by the function of other organs. I may be criticized for using "function" as I do, but I am tired of hearing dentists and physicians speak so much of function when they refer to only one function, the special use, so I have just about ruled out "function" from my vocabulary and have substituted "special use" to take its place. That is the main reason why I do not like to use the term "functional occlusion," because I do not regard chewing as a function but as a use. Do you see the distinction?

Dr. Ottolengui.—No.

Dr. Stallard.—Now what we mean by "function" in the unicellular animal constitutes all the things which that unicellular animal can do. It can absorb food; it can change its shape; it has protoplasmic movements; it can enlarge in size by water intake; it can grow following assimilation. It can digest food; it can excrete food waste and build itself over by assimilating the raw products brought into its interior. It can reach maturity, reproduce, grow old, and die. All this constitutes what I mean by "function."

What is mastication? It is simply a little part in preparing food for digestion. It is an important part, but in the general scheme of metabolism it is a small preparatory part. The mouth uses the teeth to perform that work. The teeth, so far as chewing is concerned, are destroyed by that use. So far as the teeth are concerned, they do not function in chewing but are functioned. Of course, I am getting rather academic, but I want you to see my point of view.

Dr. Ottolengui.—But it is all wrong.

Dr. Stallard.—What I mean by "function" is entirely different from "special use." The same thing might be true of the eye or any other organ having a special use. I have put this term up to men who deal in plant physiology and asked them what they mean by "function," and they are more or less put to sea by it. What they think "function" to be is really "use." For this reason I do not like the words "functional occlusion" or "afunctional occlusion," because function is the activities of an organ. Occlusion is not an organ, it is a relation.

I see we are getting back to our old quarrel, so I had better stop. While I disagree with the nomenclature of Dr. Ottolengui, I must say his paper is a very forward-looking one. Through his influence, we should admit, we have largely discarded the use of "balanced occlusion."

Dr. Ottolengui.—Hear, hear!

Dr. Stallard.—We are trying to do the things that both Dr. Young and Dr. Ottolengui advocated years ago. We call the accomplishing of this in the mouth "gnathology." If you go back and read his editorial, you will see this.

Dr. Ottolengui (interrupting).—I did not think it had reached the point yet of needing an editorial.

Dr. Stallard.—No, no, not yet.

Dr. Waugh.—May I say a few words about the fine paper that Dr. Ottolengui has given us? I do not believe he and Dr. Stallard differ very much. They mean about the same thing, one viewing it from the biologic aspect and one from the ultimate functional end.

In 1908 or 1909 I had the pleasure of reading a paper before the Second District Dental Society, and Dr. Ottolengui published it. I brought out a number of things, one of which was that in the application for orthodontia I had an attachment to add to the Snow articulator by which lasts could be mounted with a face bow and articulation of the natural teeth studied as is done in prosthetic dentistry.

At first I thought this a great help in orthodontia, but as I went along and studied the natural teeth, I realized that some of the casts of the jaws in what seemed like the best occlusion when mounted with the face bow, in an articulator with a movable slot to simulate the descent of the condyle path did not give the occlusal contacts that we expected.

Within the past three years a man interested in giving the profession a new and better articulator stated before this Society that any time the orthodontist fails to produce the balanced contact in the finished case, he is leaving a condition of traumatic occlusion which would militate against a healthy condition of the supporting structures. This statement does not check up with my observations for over twenty years, and I must agree with just what Dr. Ottolengui has said with reference to balanced occlusion for the normal dentures. The finest untreated cases we can find do not balance up and never have balanced up, as should artificial teeth when set up in an articulator.

Function is use. There is normal function and abnormal function. Abnormal function is pathology. Normal function is physiology. The use of an organ determines its strength. That is one of the fundamental things which we were first taught in physiology. Dr. Ottolengui was talking about the use of the teeth as controlled by muscles directed by nerves and supplied by blood vessels conveying food to the muscles and the nerves and of lymphatics for removal of waste products; so when he speaks of occlusion, he includes all the biologic and physiologic chain of circumstances brought into effect, so again they mean practically the same thing. There may be some little difference in nomenclature, but the philologist always has a lot of fun splitting hairs about terms, and Dr. Ottolengui and the occlusionists enjoy it, so wny rob them of a pleasure, so long as their meaning is clear?

Dr. Young brought out a fine thing, and that was the reproduction of occlusal topography of the teeth. It did a great deal of good. All good things, when misapplied, react in harm. Some men took the most nearly ideal tooth of the type, say a molar, that they could find and *always* reproduced grooves and fossa and marginal and triangular ridges as there seen, and that tooth came perhaps from a child of twelve when all the occlusal topography was at its best, but the inlay was being made for an individual of perhaps fifty-five years with occlusal surfaces of adjoining teeth considerably worn. In reproducing occlusal topography one must bear in mind the fact that the finished restoration must harmonize with conditions in the mouth of the individual at the time.

I have just come home again from a further opportunity of studying the teeth of the Eskimos. I went to find out whether the teeth of the young Eskimos have as deep fossae and finely chiseled cusps as ours. They do. Do the teeth of the old Eskimos wear down? They do.

The old Eskimos with thirty-two teeth in their mouths, with the occlusal surfaces worn down, are chewing dried walrus, seal, and whale, and dried fish, as they all do it with the greatest facility. If one made an occlusal restoration and carved deep grooves and depressions and triangular ridges, as was the ideal before they were abraded, one would be introducing a factor not harmonious in that mouth at that time, so the teeth must be carved to harmonize with the wear that has taken place as the result of attrition.

The ideal must be an occlusion that best meets the individual conditions of the patient at the time. This implies that the principles of occlusion need not be violated to bring about a functioning occlusion that will be efficient for both service and continual health of the supporting structures of the teeth.

I liked Dr. Ottolengui's paper very much. I also liked what Dr. Stallard said in its discussion.

Dr. Ottolengui.—I am a little bit surprised that Dr. Stallard has not changed his mind since we were out in Louisville, because he said then, after hearing my paper, just what he

said today, and I think if he had read my paper after he got home he would not have said the same thing today. Why? Because I did not speak in that paper of functional occlusion without telling what I meant by function.

Function includes the use of an organ and all that results from the use of that organ. In addition to "use" there are two other "uses," "ab-use" and "dis-use," either one of which produces a pathologic condition.

I said in that paper, and I am perfectly willing to adhere to it, that in correct functional occlusion we have what I called then a new term, a "virtuous" circle, to distinguish it from a vicious circle so commonly found. This virtuous circle would mean that the use of the teeth causes a reaction through the pericemental membrane which causes an extra amount of nourishment to reach the bone and to invigorate the environmental parts of the teeth; so in the end mastication is only one stage of the function of the teeth.

Aside from that we have the function of articulation, that is, correct speech, which should be considered, but that is another story.

I think that is sufficient to say here, except that I do not believe for one minute that there is any difference between Dr. Stallard and myself except that he likes the California terms better than those we have in the East. I do not care whether it is "functional occlusion" or "coordination of cusps," because I can tell him that "coordination of cusps" is necessary to "functional occlusion." I am talking about the incorrectness of "balanced occlusion."

Here is a strange fact, and I fear the orthodontists, and periodontists, and many other men have overlooked it: An all-wise Providence, foreseeing that the use of the teeth would destroy the points of the cusps, so constructed the teeth that as the enamel is worn off by attrition and the dentine is exposed, the dentine wears away by the attrition, not of the teeth, but of food, producing hollow places and making the tops of those teeth not just smooth as you make them with a grindstone, and as many of the periodontists are doing, but still with a functional topography which enables them to produce functional occlusion for old people.

A CONSIDERATION OF EXTRAORAL PRESSURES IN THE ETIOLOGY OF MALOCCLUSIONS*

By Harvey Stallard, D.D.S., San Diego, Calif.

INTRODUCTION

Malocclusion and Biology.—Etiologic studies of malocclusion involve inquiry into certain environmental factors and their corresponding physiologic reactions. Possibly certain body developments are no longer directly or were ever primarily influenced much by any external factors, but they are indeed few. Responsible environmental factors may be divided into two classes: those which affect the general metabolism of the child, and those that affect its face locally. The former are typified by such examples as diet and pathogenic agents; the latter, by habitual pressure or traumatic blows against the teeth, dental arches or jaws.

Theoretically those embryologic faults such as cleft palates, congenital absence of teeth, supernumerary teeth, or misplaced tooth germs, belong to the class of developments which are probably uninfluenced by direct primary environmental factors. At least, our ignorance of any environmental correspondence between the ensuing malocclusions occasioned compels us, for the present, to list such in the nonenvironmental class. However, multiple congenital absence of teeth sometimes accompanies syphilis and suggests a possible relationship, so that this, as many other classifications, must be regarded as provisional.

It is evident that solutions of the etiologic problems of malocclusion are as difficult as those of any other biologic problems. In fact, in this study are epitomized most of the major problems of biology, namely, hereditary variations, endocrine disturbances, postural influences, biomechanics, etc. A complete solution of the etiologic problems of malocclusion rests upon final and complete knowledge of the above biologic problems.

Physiologic Complexes Versus Environmental Simplicity.—Understanding of the etiology of malocclusion is further complicated by the wide range in the degree of its development in different children who have similar habits, identical rates of growth and apparently the same states of health. The factors influencing the growth of the denture never work singly and cannot be made to operate alone, which makes experimentation difficult. Usually, each malocclusion results from at least two sets of factors, one of which is the physiologic and the other the environmental. The former is always complicated, the latter may be comparatively simple. Extraction from a diet of its salts and vitamins necessary for normal bone growth may be done directly and simply, but the pathologic physiology of the starved skeleton is considerably involved. What a complex is thrown into the physiologic mechanism by sim-

*Read before the New York Society of Orthodontists, New York City, October 14, 1929.

ply excluding from the diet all traces of iodine! Simple introduction of pathogenic agents into the body may produce complexes which will destroy life remorselessly.

The physiologic misbehavior through a lack of necessary environmental factors or by the presence of pathologic agents may not be easily understood, but its prevention in others can be effected by correcting the corresponding external contacts. An understanding of a life process is always made more comprehensive by identifying its environmental correspondence. Wherefore, it seems both logical and profitable to look to the environment in order to find in it factoral correspondence for forms of malocclusion.

PREVIOUS ATTEMPTS TO DISCOVER SUCH CORRESPONDENCE

Diet and Use.—This is by no means a new attitude for orthodontists. Among their first attempts to account for the general prevalence of malocclusion was the explanation based upon a change in diet from the natural hard tough foods to the overmilled and overcooked stuffs. They held that such foods did not furnish enough exercise to develop the jaws large enough to accommodate the tooth crowns, which prior to eruption were cast in their adult sizes. They had, no doubt, been influenced by the Lamarckian and neo-Lamarckian doctrines that exercise of the special function of an organ is necessary for its full volumetric development. They studied meticulously the anatomy of the jaws, the muscles operating the jaws, the tongue, cheeks, lips and throat with a view to prescribing exercises which the patients might perform to compensate for the nonexercise compelling diet.

Metabolic Functions.—As our knowledge has grown, dentists have learned that metabolic functions develop certain organs to almost their full volume before they assume their special functions. This is notably true of the eyeball, the dental enamel, the gonads, the internal ear and the genitalia. The orthodontist has learned that a large portion of the denture is formed in uterine life before any of the special oral functions are exercised. Hence, the followers of Lamarck modified their theories in this way—they said that chewing brings to the denture more blood which provides for greater metabolism by furnishing more blood nutrition and local pressure for growth. However, they could not by such a theory account for the several different types of malocclusions and were compelled to look for other explanations.

Perverted Breathing.—The next explanation of remote environmental basis was that of mouth-breathing, a special function reassumed by the mouth whenever its evolutionary derivative—the nose—becomes more or less permanently clogged through infection and swelling of the tonsils and adenoids. This, they claimed, instituted perverted mechanics which shortened the mandible sufficiently to change the cusp relationship, which thereupon perverted the masticating forces so that with each closure one jaw was driven forward and the other backward. The contraction of the upper jaw, they imagined, was due to the drawn upper lip and to the negative atmospheric pressure within the nose which permits the positive external air pressure to collapse the bodies of the maxillae and the nasal chambers. The curved nasal septum, they claimed, resulted from the high palate which had been also sucked up-

ward by negative pressure. The prevalence of colds and nasal disease they attributed to such environmental factors as improper diets, house confinement, and improper clothing in a race congested in dense populations which make epidemics possible. The importance of an anatomic understanding of the mouth and nose was also emphasized by the advocates of this theory who likewise prescribed exercises of jaws, throat, lips and chest to overcome the lack of development thought to be occasioned by the perverted respiration and mastication. But these theories combined could not account for asymmetric malocclusions which constitute the bulk of oral deformities.

Early Loss of Deciduous Teeth.—The time-honored theory of explaining asymmetry in arch length is that of early loss of deciduous teeth. But asymmetry in width and depth of the denture could not be so directly and rationally accounted for by perverted breathing, lack of vigorous chewing, or by too early loss of teeth. Most fatal to the theory of early loss of deciduous teeth was the discovery that nearly all the symptoms of malocclusions appear in nonmutilated deciduous denture. The presence of easily noticeable malocclusions of the usual sorts in children just erupting their first deciduous molars discounts greatly the theories of nonuse in chewing and misuse in perverted breathing, because the child is not supposed to have used his jaws so vigorously or his chest so strenuously at this tender age.

Thumb-Sucking and Nail-Biting.—The century-old explanation of characteristic malocclusions from thumb-sucking is rational, although certain thumb-suckers may escape unmarred. The thumb is an external factor and becomes a part of the child's mouth environment by being habitually introduced therein. This habit is ofttimes associated with habitual prone postures. Bottle-feeding has long been held responsible for similar malocclusions, on two counts: (1) because it provides habitual pressure, and (2) because the ingredients of its contents were insufficient. The nipple is an external factor comparable to the natural nipple in many respects. Both habits, by supplying more pressure to one side of the mandible, can reasonably be regarded as instrumental in producing unilateral mandibular retractions in children affected by unilateral habits. Those habitual suckers who escape injury probably exert little air pressure and have no other external sources of pressure applied constantly. Finger-nail-biting no doubt modifies the denture, but its influence is not so easily identified as that of the sucking habit.

Tongue Conditions.—The tongue has considerable influence in determining the volume of the oral cavity proper. When confined almost exclusively to the lower arch by the maxillary arch being extremely narrowed, it deepens and widens the apical base of the former, sometimes inordinately. Occasionally, children habitually bite their tongues, or during the act of swallowing, either on a side or in the front of the denture, causing an open-bite. Such habits represent true perversions of the tongue which, strictly speaking, cannot be classed as an environmental factor of the mouth, but, at bottom, is such to the teeth. Possible overgrowth of the tongue may account in part for oversized arches with spaced but regularly interdigitated teeth. Orthodontists who endeavor to account for most malocclusions by perverted mouth mechanics have tried to explain unilateral V- or saddle-shaped contractions

by assuming that the tongue withheld its pressure from the affected side and thus permitted the lazy weight of the cheek to compress the arch.

Alleged Oral Perversions.—Habitual biting, sucking or tensely compressing the lips and cheeks have been considered by Angle as grave and major causes of gross malocclusion. He believes, however, that they merely initiated the trouble by disturbing the equilibrium in the forces which he imagined are delicately balanced about the fictitious "line of occlusion." The deep gashes frequently found in the cheek and lip mucosa of children wearing labial arches he formerly attributed to such habits. His emphasis of these habits, which he regarded as nervous reflexes in the children of a civilized state, led several of his students to make psychology a special retreat in the hopes that there they might find ways of preventing such habits and much malocclusion. Angle, even today, considers jaw deformations to be the results of the great chewing stress being perverted through the teeth when they have wrong inclined plane relations and lean out of line with the closing forces. According to him, gross malocclusion has grown out of the malmechanics instituted by the slight malocclusions. Thus his thought on the subject is most remote of the other mentioned theories from having an environmental basis. His analysis is of pure physiologic origin and may be epitomized in the words, "The mouth deforms itself through use, after acquiring a slight imperfection in the balance of its operating forces."

Chemical Factors.—In their search for causes, orthodontists have not slighted the chemistry of foods, particularly those elements found in foods which supply bone its necessary salts. But until recently they had no way of satisfactorily explaining why certain rachitic children escaped malocclusion, why the deformities were so varied in form and degree of development, and why the nonrachitic had the same malocclusions similar in kind and degree. The funnel chest of the rachitic is explained by the constant tension of the diaphragm; the bowed legs and flat feet are explained by the body weight; the stooped shoulders and the curved spine, by the weight of perverted posture; the flatness of the occiput, by the weight of the head exerted upon it in sleeping postures. But the malocclusions of the rachitic are so various that they bewilder one trying to explain them upon the basis of natural muscular stress.

Postural.—The general consideration of sleeping postures as probable causes of malocclusions is relatively new, although as early as 1903, George T. Baker attributed a case of malocclusion to a sleeping habit in which the child exerted constant pressure against the mandible. Ten or more years ago Calvin Case explained lateral malocclusions by the pillowing habits of early infancy.

REVIEW OF AUTHOR'S WORK ON POSSIBLE EXTRAORAL PRESSURES

A history of my activities in this clinical investigation of sitting and sleeping habits together with traumatic blows against the denture might be of interest to the profession and assist orthodontists to evaluate properly the importance of the observations thus far made. Having been trained as an ecologist, it was only natural for me, when I entered the field of orthodontia,

to look accusingly at the environment of the face to find in it causes of malocclusion. In the fall of 1920, I began asking parents how their children slept. By January of 1921, I had become convinced that parents were poor observers, and I resorted to making visits to bedsides to study those suspected. This I continued in private families, and at three different children's homes in San Diego. After studying some 300 individuals in their sleeping environment, I published in *Dental Cosmos,* 1923,* a preliminary report with conclusions that cross bites, saddle-shaped and V-shaped dental arches are the result of hand, arm, shoulder and face-pillowing. In *Dental Cosmos,* 1924, after refuting objections raised against the extraoral habit theory, I discussed analytically the mechanic of perverted axial stress, once thought to be an important contributory factor in perpetuating and increasing the range and intensity of the deformations started by the external pressure. In May of that year, Dr. Scott E. Watson found an individual with a malocclusion of such proportions that he claimed external pressures to be more important than perverted axial stress. After studying the patient which I reported in *Dental Cosmos,* November, 1924, I readily concurred with his opinion and have ever since disregarded perverted dental axial stress as a factor of any importance.

At the request of some local physicians, I published in the *Journal of Western Medicine,* May, 1924, an article entitled "Effects of Pillowing on the Development of the Upper Jaw." Upon invitation from the late Editor Musgrave, I published in June, 1924, in *Better Health* an article on "The Development of Posture During Sleep." During the summer of that year at the Coronado Hotel, as part of the Program of the Annual Meeting of the Southern California State Dental Association, assisted by a group of dentists, but chiefly by W. E. Walsh, Harvey Jackson and Scott E. Watson, I prepared and rendered a clinic showing how resting habits could be held partly responsible for developing the following deformations of the denture:

(1) Attraction
(2) Contraction of either jaw or of both simultaneously
(3) Retraction of either jaw separately or of both simultaneously
(4) Protraction of the mandible

The substance of this clinic was published in *Dental Cosmos,* February, 1925, entitled "The General Relation of Pillowing to the Development of Malocclusion." In the fall of 1924, Dr. Watson and I began making a dental survey of the San Diego county rural school children. He was interested particularly in the prevalence of dental disease and I in the percentages of various types of malocclusion. By this time I have recorded observations based on cranial and facial examinations of more than 7,000 children, 1500 of which were of preschool age. In the survey, I have been influenced by the observations and examinations of the physicians, particularly those of Dr. Alex Lesem, the city and county health officer. As observations have increased, I have become suspicious that sleeping habits have a far wider influ-

*C. C. Benton, D.D.S., furnished illustrations in Figs. 15, 20 and 25 and photographed subjects studied by me in Figs. 17-*B*, 18-*A* and 24-*A*, *C*. He accompanied me on three occasions to see sleeping children. Since May, 1923, he has not assisted me in any way.

ence upon the shape of the denture in those children who suffered from malnutrition or childhood illness than in the healthy. Healthy, rapidly growing children sleeping habitually upon their faces will have only slight malocclusions unless they happen to have unusually large heads. Health factors of the individual merit as much consideration as habitual external pressures. A combination of both sets of factors, malprotoplastic and environmental, are necessary to produce the most grotesque facial deformations. Sickness prolongs the practice of the habit and often increases the plasticity of the growing tissues. In a paper read before the Orthodontic Association of Chicago, October, 1925, I gave a complete account of my views on the importance of health factors. The substance of this paper was published December 18, 1926, in an article entitled "Usual Maxillary Deformations" in the *Journal of the American Medical Association,* having previously been read at Dallas, April, 1926, before the Section on Laryngology, Otology and Rhinology of the Medical Association.

Since 1926 I have been gradually accumulating data of the frequency with which malocclusion appears in children at the various ages of infancy and childhood, because when I first reported my observations on the relation between hand- and arm-pillowing, orthodontists of experience would admit that such were probably the cause but said that these malocclusions are infrequent. I have found that 20 per cent of the children appearing at the preschool age clinics have malocclusions that may be attributed in part to such habits. Of the children having malocclusion before the age of six years, 33 per cent, I have found, have malocclusions resulting from pillowing upon a part of the upper extremity. The maxilla is more often affected by the unilateral contraction, the right side suffering more frequently and more intensely than the left.

In 1922, while discussing the etiology of malocclusion from the standpoint of the malmechanics of mouth-breathing with Dr. Carlos Lustosa, Rio de Janeiro; Dr. Mendell Stallard, who had studied my observations very sceptically, proposed that all three forms of malocclusion (Angle) might be influenced in the course of their development by external pressure. Soon after that I found that children having the so-called Class II Division 1 malocclusion in which there is contraction of the maxilla had been belly sleepers from infancy and usually had pronounced development of the posterior cranium. In certain individuals having mediocre posterior cranial proportions, the mandible may be retracted without being much contracted and be opposed by a non-contracted maxillary arch. Such a form of malocclusion may be attributed to chin-propping and is usually accompanied by considerable attraction, because the reactive force is upward and backward.

The first case I ever studied to any extent was in a child who was developing a unilateral mandibular protraction and was found sleeping with his fist back of the mandibular angle. I have been influenced to believe that pressure habits might cause mandibular protractions as well as retractions.

During the winter of 1924 and 1925 Birger Kjellgren, Stockholm, who was much impressed with my observations, conducted some experiments on himself and found that perceptible contraction of the maxillary arch could

be obtained by resting his face on a ball exerting a calibrated amount of pressure. His experiments were published in the *Dental Cosmos,* 1925.

FACTS SUPPORTING THE EXTRAORAL PRESSURE THEORY

Pressure of Such Habits.—The first question of fact to be raised is, do children having these malocclusions have the corresponding resting habits? If not, have they ever had these habits in the past and corrected them spontaneously or unintentionally? In young children, I have usually found the habit when I searched for it. Sitting habits in which cheek-, lip-, or chin-propping are indulged are abundantly available for observation, and the corresponding restrictions in oral growth often check positively.

Pediatric Customs.—Pediatricians inform me that they make it a routine practice to keep bottle-fed babes on their stomachs to vent off the gases. The esophagus of the infant is dorsal to the stomach, and, hence, gas swallowed during sucking escapes automatically and more rapidly when the child sleeps ventrally. The so-called narrowed form of Class II malocclusion appears with such frequency in controlled pediatrics practice that I am tempted to call it "pediatrics malocclusion." Perhaps experienced orthodontists have wondered why malocclusions of such proportions appear in children of careful families who rear their children under strict pediatric conditions. These practitioners have criticized me because they say "back-sleeping" distorts the cranium (which is the first part of the skull to mature). Orthodontists have in times past believed the underdeveloped jaws resulted from the children eating a too-soft diet prescribed by these scientific medical specialists. This explanation never satisfied me because modern civilized children actually chew tougher foods and begin eating solids earlier than the savages and peasants of older countries who nurse longer and often eat the foods chewed by their mothers.

Purpose of Exercise Is Coordination.—The scientifically discounted theory of Lamarck, namely, that lack of development is due to a lack of special use has never seemed reasonable to me in its application to denture deformations because the special function is not assumed until the organ is a third developed by the general metabolic functions. Special functions benefit organs just as long as the damage they do can be fully repaired by the general metabolic functions. In muscles too much exercise causes hypertrophic conditions. A principal purpose of exercise is to establish and maintain a coordination so that the maximum work can be done with the minimum effort of the muscles.

Internal Cooperants.—Strictly speaking, resting on the face is not an oral function but is a use made of it which is detrimental enough to be regarded as a misuse. The maladjustments ensuing, I believe, can be somewhat overcome in the healthy child by the vigorous metabolic functions. The question then arises, can we have malformations from poor metabolism by the natural forces of the organ? I would not be surprised that some of the mild forms of the malocclusion occurring in the rachitic are due partly to such, but on the other hand I have seen rachitic children escape being deformed and

have seen in others unilateral oral and facial flattening on the pillowed side. If the deformation were due to mouth forces, the malocclusion should be symmetrical.

Malocclusion Accompanying Unilateral Face Burns.—In children who have been burnt accidentally on one side of the face, it has been my surprise to find the more normal occlusion on the burnt side and the abnormally contracted on the other. I can conceive of no explanation for such deformations based upon natural perversions. Such subjects furnished me the first clues by which I later believed I was able to read in an adult his past reclining habits. There is a correlation between the vertical posture and the most habitual sleeping posture which can be ascertained clinically by a study of the body, as can be demonstrated by a series of photographs showing the various postures of the body. Upon such evidence I have tried to base diagnoses in subjects of their past habits of reclining when I could not have access to their bedsides.

Correlation of Cranial and Facial Forms.—The majority of the children appearing with flattened occiputs posteriorly or on one or both sides usually have normal mouths, at least expanded arches. Those children having perfectly formed posterior craniums usually have pronounced malocclusions.

Relation in Form of Pillow-Object and Malocclusion.—The various saddle-shaped arches, as may be demonstrated, correspond in their configuration to the shape of the body around which they have been partly moulded. Bimaxillary saddled arches are sometimes produced in normal breathers who have slept with their cheeks pressed against the shoulder, a habit in which the mandible seldom escapes pressure. In the rotation the teeth in such contractions have their transverse diameters arranged radially to the center of the object exerting the pressure. These rotations are more or less characteristic, as can be shown by comparing a number of cases. In the truly V-shaped arch the teeth from the second maxillary molar forward have been rotated mesiolingually, characteristic of contractions produced by a straight and long object pressed against the arch.

Cheek Wounds From Appliances.—Children having habits of leaning or sleeping upon the sides of their faces will cut their buccal mucosa almost through if the appliance is small and at a distance from the teeth. If it lies close against the teeth, the gash is as deep as the diameter of the appliance. From studies made by having children rest directly upon the appliances, it has been found that a child will have to lie more than four or five hours daily upon the appliance in order to produce in his cheek such angry gashes. Operators using labial and buccal appliances have ofttimes been embarrassed when these gashes appeared, causing the patient and parents to protest. There have been various suggestions made to cover over the appliances with cotton or paraffin to prevent the newly set apparatus from wounding the cheek, it previously having been assumed that the wounds resulted from voluntary cheek contractions against the appliance. But sores from the friction caused by cheek activity are shallow and broad, those from external pressure are definite, deep and continuous. If the patient has two different habits on the

same side, there will be two gashes. These wounds heal rapidly when the face is kept free from pressure. Such cuts do not appear in children who lack face leaning or pillowing habits. The face-sleeper who rests his cheek or lip against the soft bedding has a definite imprint of the appliance in his cheek but does not develop such angry sores as when his cheek rests against a part of the upper extremity.

Bulky Appliances and Successful Prognosis.—The large buccal arches formerly used and worn for long treatment periods were distinctly advantageous in such cases, because they compelled the patient to find new pillow habits in which the cheeks would not be made sore. Where the appliances were worn for several years and with headgears and bridle retractors, these alleged causative habits were completely broken. It has been interesting to see what large amounts of scar tissue appear in the cheek mucosa in patients who have had their saddled contractions corrected by orthodontists who used these bulky clumsy appliances.

CRITICISMS AGAINST THE EXTRAORAL PRESSURE THEORY

Therapy and Causes.—Much criticism against this explanation of the cause of malocclusion, as has already been shown by me, issues from those holding such theories as nonuse, misuse, perverted mechanics and mouth-breathing. These theories have been adopted by clinicians viewing malocclusion from their own therapeutic point of view. They desire to confirm their therapy because they want to justify their methods. In other words, the clinician is apt to evolve a theory of etiology which will justify his method of interception. For instance, the first permanent molars are most needed for anchorage in treating malocclusions; hence, there has grown up everywhere the belief that these teeth, when perverted in inclination and intercuspation, are largely responsible for most cases of retraction and protraction. Angle as late as 1922, while evolving the recently published and advertised appliance, actually believed that he could correct mandibular retraction by merely erecting the buccal teeth, hence the "picket-erecting" principle in appliances. If malocclusion be due, as Angle avers, to the perverted mechanics of the mouth in chewing, ideal results can be attained by the use of his appliances.

Nontherapeutic Etiology Pessimistic.—If, on the contrary, malocclusions are due to external pressures cooperating with malprotoplastic factors, then in most cases our hopes of obtaining ideal results by using the present intraoral appliances and mechanics are forever blasted, because the deformities of the maxillae are accordingly not reciprocal deformities of the mandible and the jaw distortions are not results of the malocclusions but companion results. If such be true, then all our orthodontic results obtained by internal anchorage, in serious cases of malocclusion, are vain compromises, even where we do not try to jump the mandible forward or sidewise. So seriously does the extraoral pressure theory challenge our orthodontic therapy that it should be submitted to the most severe critical tests before launching on other forms of therapy or prevention. Already operators accepting the theory of resting-habits as of etiologic significance have unloaded their responsibilities of main-

taining their results upon the shoulders of the patients and, by shortening the retention period emphasized so thoroughly by Kingsley, have virtually neglected their hard-earned results.

Lack of Experimentation.—The most direct and valid criticism of this theory is the fact that no one has ever experimentally produced malocclusion by controlling the external and internal etiologic factors. The coincidence of the habit and the deformity may cause a conclusion on the part of the observer constituting a fault in logic which might be paraphrased as *cum hoc, ergo propter hoc,* meaning "with this, therefore, because of this." Proof can never be had until malocclusions are experimentally produced in animals and humans who will have been taught to acquire and practice some of these habits. In the second place, it must be shown that the most typical forms cannot be otherwise produced. The present attempt to prove this by negative evidence, namely by finding normal subjects sleeping in different positions does not constitute sufficient confirmation.

Vagueness of Internal Factors.—In the third place, the observations thus far made are qualitative and are not associated with anatomic or histologic studies of the dentures so deformed. We need above all to establish means of measuring bone plasticity and methods of calibrating its response to definite amounts of pressure, otherwise the word "plasticity" will remain empty and vague as applied to bone. There should be some clinical way of determining accurately bone density and bone response to applied forces. The relation between dietary factors and plasticity could then be more definitely determined.

Interpretative Methods.—A fourth criticism of this work is an attack upon the methods of obtaining the correct history of a child. Obtaining histories from parents is so difficult that some of our most experienced operators have stopped taking many details and do not regard their records very seriously. The attempt to go back into the past habits of a child, as in history taking, is largely an interpretative method. You may see the child practicing a habit, but how can you know positively how long he has practiced it? Resorting to psychology as a proof of the past existence of a habit avails us little, because psychology in this application is also largely an interpretative philosophy.

Again, the attempt to diagnose the past habits of a patient by studying the form of his body or by the manner in which he walks is an interpretative method which like many other diagnostic methods may or may not lead to right conclusions. Interpretations are necessarily neither facts nor truthful correlations of facts. Not many years ago opticians held that lateral spinal scoliosis was caused by leaving astigmatism uncorrected. Chiropractors using interpretative means exclusively make at times surprisingly good guesses, but such methods can hardly be held as scientific.

The method of finding a correspondence between the shape of the object rested upon and the deformity existing in the arches is a crude method used in the early days of comparative anatomy. But science demands more than descriptions and interpretations.

JUSTIFICATIONS OF THE THEORY

Since I have been accorded the privileges of making examinations wherever I please in California, I am less concerned than ever in having favorable criticism or confirmation by other observers. The methods I have used can be justified only by keeping ourselves reminded that malocclusions exist principally in their grossest form in human beings, with whom experimental procedure is difficult. We may have to continue indefinitely with the present clinical means, but we should not deceive ourselves and keep contented in the use of methods held to be insufficient in other scientific fields. However, we can experiment somewhat socially by changing our sleeping habits in infants and by discarding chin and cheek propping.

In spite of all the criticisms against the extraoral pressure theory, there still remains sufficient evidence to warrant its consideration and the prosecution of its further investigation both clinically and experimentally. In conducting a practice in which such causes as the malprotoplastic and the external factors are regarded as accountable for malocclusion, naturally the orthodontists will endeavor to remove the external pressure and to correct through diet and hygiene the internal factors as well as the external.

Fig. 1 is of importance to show that I am cognizant how tongue pressures cause symptoms of malocclusion, the open-bite, which may be confined to the anterior portion of the mouth (*A*), or to one (*E*) or both sides, or range extensively from the posterior molar on one side around to those on the other side (*F*). Dr. Waugh, at the recent Washington American Dental Association Meeting, showed cases very much like these along with treatment methods. Internists often describe patients having open-bites as being tonguey (*B* and *C*), a symptom indicating a possible disturbance in thyroid metabolism. Sometimes, under an internist's treatment, these bites will automatically close, and sometimes, they are corrected without any treatment of any sort. In other instances, orthodontic treatment will fail and apparently injure the roots of the teeth, as may be noted in Fig. 2 where more than a half of each anterior root shows resorption in the radiographs. This patient had been treated five years prior to my own attempts, which extended over a period of three years and without desirable results.

In order to present the various forms of hand-, arm-, forearm- and shoulder-pillowing, I have arranged the exhibits so that those in which the shoulder and arm are employed are displayed first. The patient in Fig. 3 came to me in 1924, stating at the consultation that she believed that she had damaged her mouth and face largely by the way she had pillowed. The habit on the right differs from that on the left; on the right (*C*) the knuckle is embedded into the cheek against both jaws; on the left (*A*) the arm is pressed into the cheek exerting most pressure against the maxillary teeth. There is distal occlusion on both sides but more upon the left (*D*), which I have attributed to the right sleeping habit in which pressure is directed in a way to shorten the left side of the mandible, probably by making the left angle more acute.

Fig. 4 illustrates a habit in which the patient rests the cheek upon the forearm producing a fairly symmetrical maxillary constriction; however,

Fig. 1.

critical examination will disclose asymmetry. Patients may also sleep with the pillow between the cheek and the arm or forearm, a more usual method, in which cases the deformities are similar to those here presented but accordingly less pronounced.

Fig. 5 represents a case that I studied early in 1924. When the patient came in for consultation, I thought I saw enough deformity in the metacarpal bones of the first fingers (*D*) to diagnose the habit. From an examination of her posture, malocclusion, and the shape of her hands, I decided that she must have had the habits here illustrated. Accidentally, my guesses proved correct. By this combination of hand and arm the child was able to retract all of the anterior maxillary teeth, perhaps the whole maxillary apparatus. During treatment she presented badly lacerated cheeks which we later prevented recurring by harnessing her in bed so that she could not indulge the habits. In the retention period she began discarding the harness, and cuts from the small closely adapted wire (0.030″) of the retainer appeared in the cheeks.

The patient shown in Fig. 6-*A, B, C, D* has the same habit as that in Fig. 5, but practiced it exclusively on the left side. From her history, I decided that she probably began this habit during the time she had a tubercular abscess on the right side of her neck.

The malocclusion displayed in Fig. 6-*E, F, G* is that developed in a child who practiced thumb-sucking while sleeping on the back of the other hand (*E*). She was still nursing the thumb when I first saw her.

Fig. 7 shows another habit in which the knuckle of the first finger is pressed against the maxillary teeth on the left side (*A*). I believe, if you stretch your imagination, that you can see the imprint of the same in the maxillary alveolar arch (*D*). On the right side (*C*) the child rested the cheek upon the back of the hand which in turn rested upon the pillow. The dissimilarity of the right and left pillow habits may account for the asymmetry of this maxillary contraction (*B*).

Fig. 8-*A, B, C* shows a pillow habit and associated malocclusion in which the basal portion of the back of the hand rests against the left side of the cheek and the back of the wrist against the mandibular teeth and jaw. The right and less habitual form exerts most pressure on the posterior portion of the face.

Fig. 8-*D, E, F* is casts of a physician who slept on his stomach with his arm beneath the pillow, somewhat like in Fig. 3-*A*, and exerted pressure against the maxillary buccal teeth. During childhood attempts to correct his malocclusion had been made, which, he said, hurt more at night than during the day. The success or failure is evidenced by the casts here presented.

The series of pictures in Fig. 9 are those of a child studied in 1923 when I was trying to correlate the vertical posture with the sleeping, for I was laboring under the belief that I could not account for malocclusion by extraoral pressure unless I found it was continued by some habit during the day, so thoroughly had I been tutored that teeth respond in movements only to continuous "delicate" forces. It was this study that made me take cognizance of chin-propping, cheek-resting, angle-pushing, and several other habits

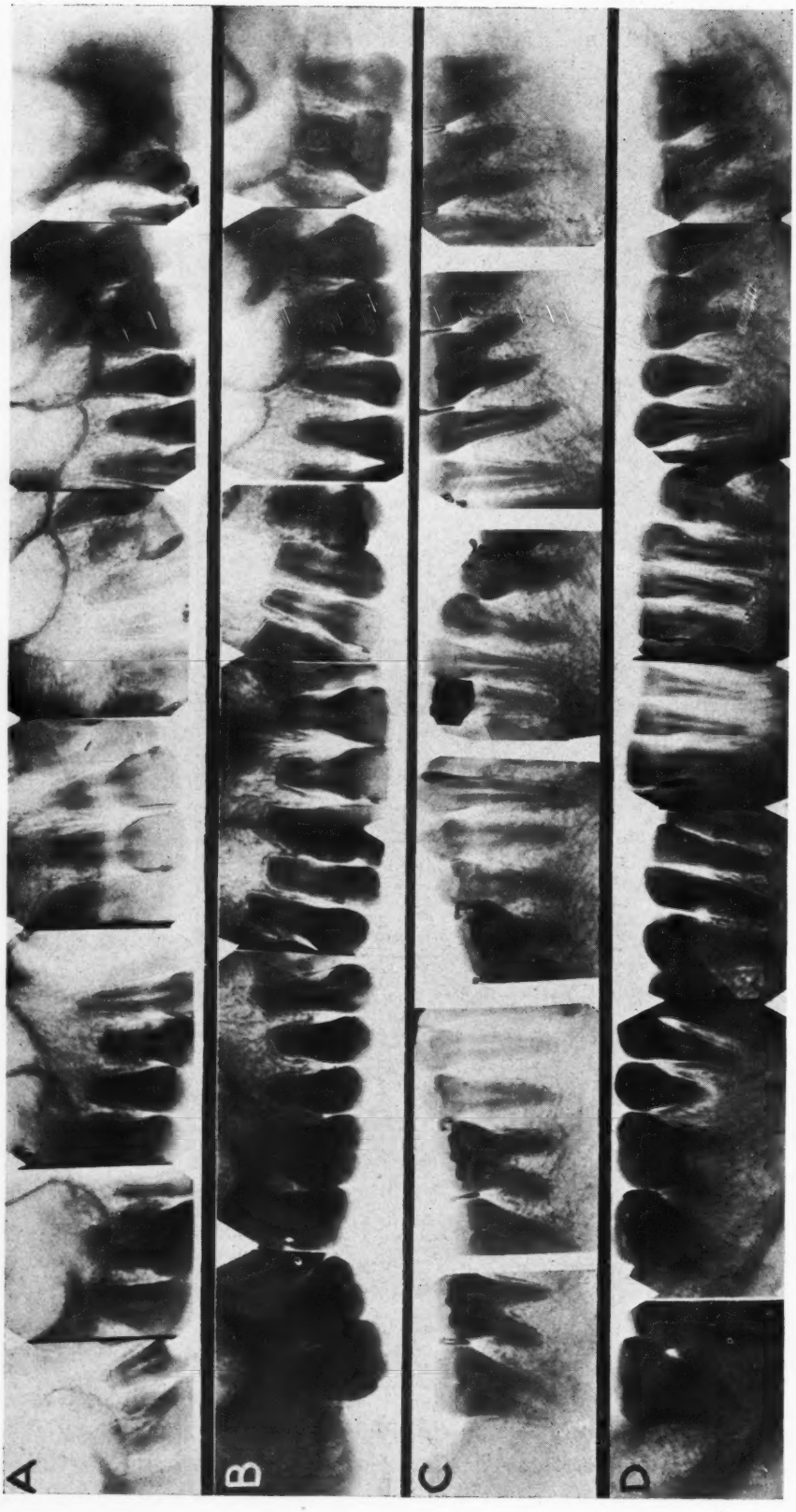

Fig. 2.

which children show in schools, in homes, or in bed, when awake but resting or studying. *D* represents the habit during active attention; *E*, during passive attention; *F*, that of a weary school child.

Fig. 10 happens to be the picture of Dr. Lasher whose habit Dr. Benton studied while the two were rooming together. Dr. Lasher in taking this picture of himself, I thought, had his hand up a little too high in the face, but upon checking it I concluded that he had the hand in about the habitual place, since the hollow of his palm came opposite the maxillary first molar which was less lingually displaced, and the thumb and the hand-heel pressed respectively upon the second molar and the premolars, causing proportionately greater displacements (*B*).

Fig. 11 shows pictures of the mouth and sleeping habits of a child whose maxillary retraction I attributed to these habits. As a matter of fact, the pressure in her habits was more posteriorly directed, but in the poses here we were interested in displaying her hands which in more true poses would have been obscured.

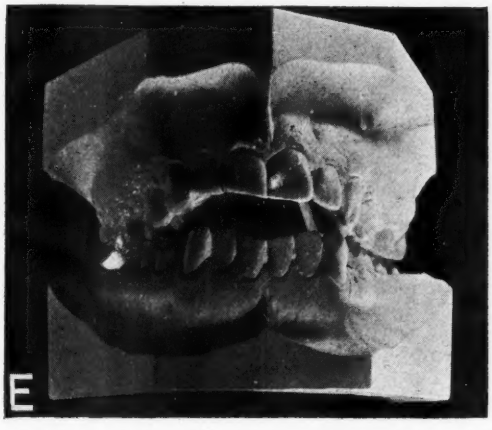

Fig. 2. (Cont'd)

The pictures of Fig. 12 show malocclusion at its maximum development. The maxillary apparatus is contracted and retracted inordinately, but the mandibular is expanded. There is and has long been a great lack of occlusion. When Dr. S. E. Watson, San Diego, showed me this case, he said in substance: "Here you have a case in which the teeth in occlusal contact are less disturbed, although leaning, than those not in occlusion. It is impossible to account for the contraction on the right side by perverted axial stress. Since the maximum part of the deformity is not caused by perverted axial stress, how can you consistently attribute smaller tooth displacements to perverted axial stress?"

Of course, holding the tongue against the maxillary teeth during eating and between the opposing teeth in rest positions has kept occlusion unestablished. But I cannot imagine that such a tongue force could contract the maxillary arch, nor can I assume that the latter has collapsed on account of the tongue withdrawing its pressure.

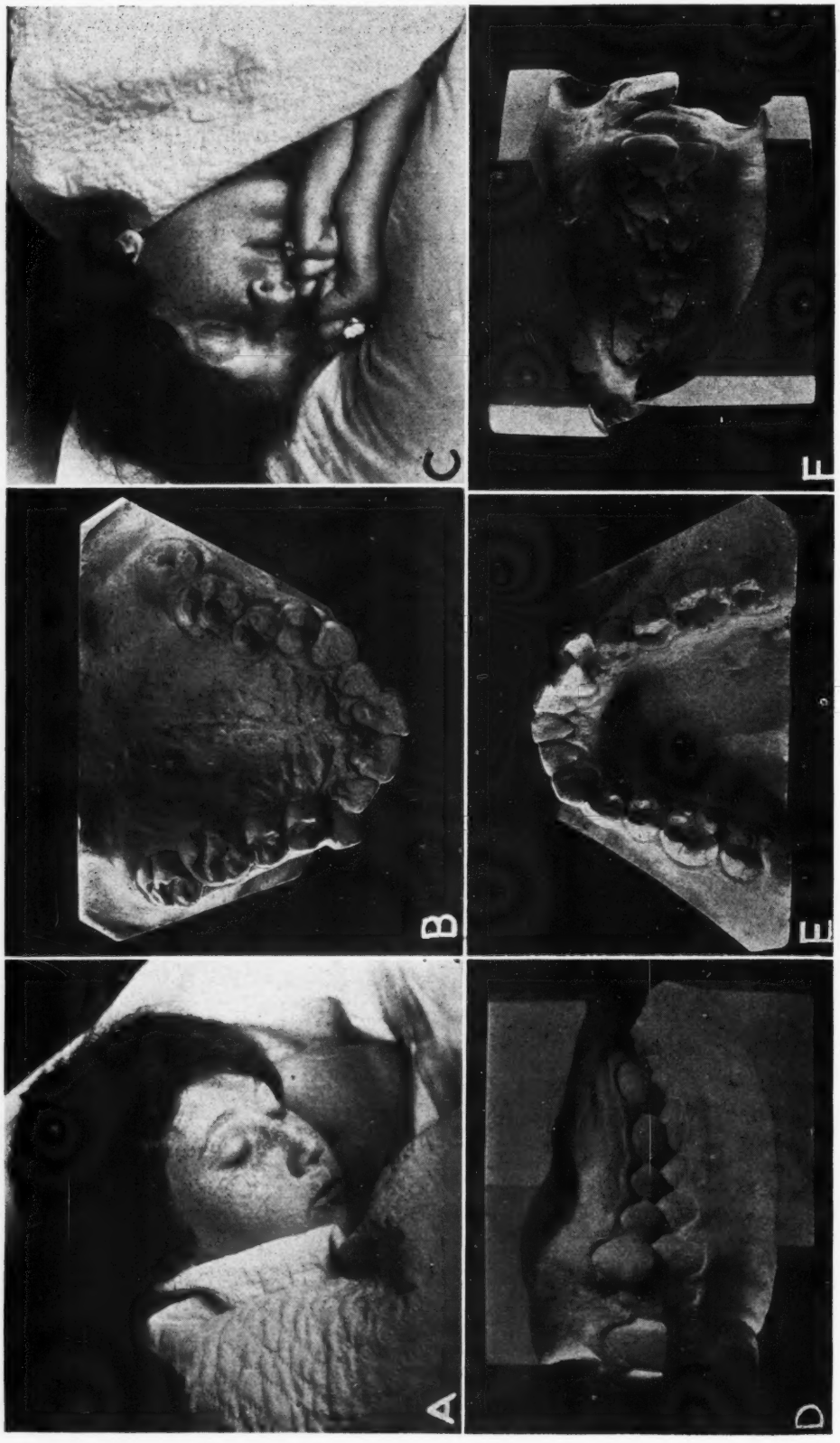

Fig. 3.

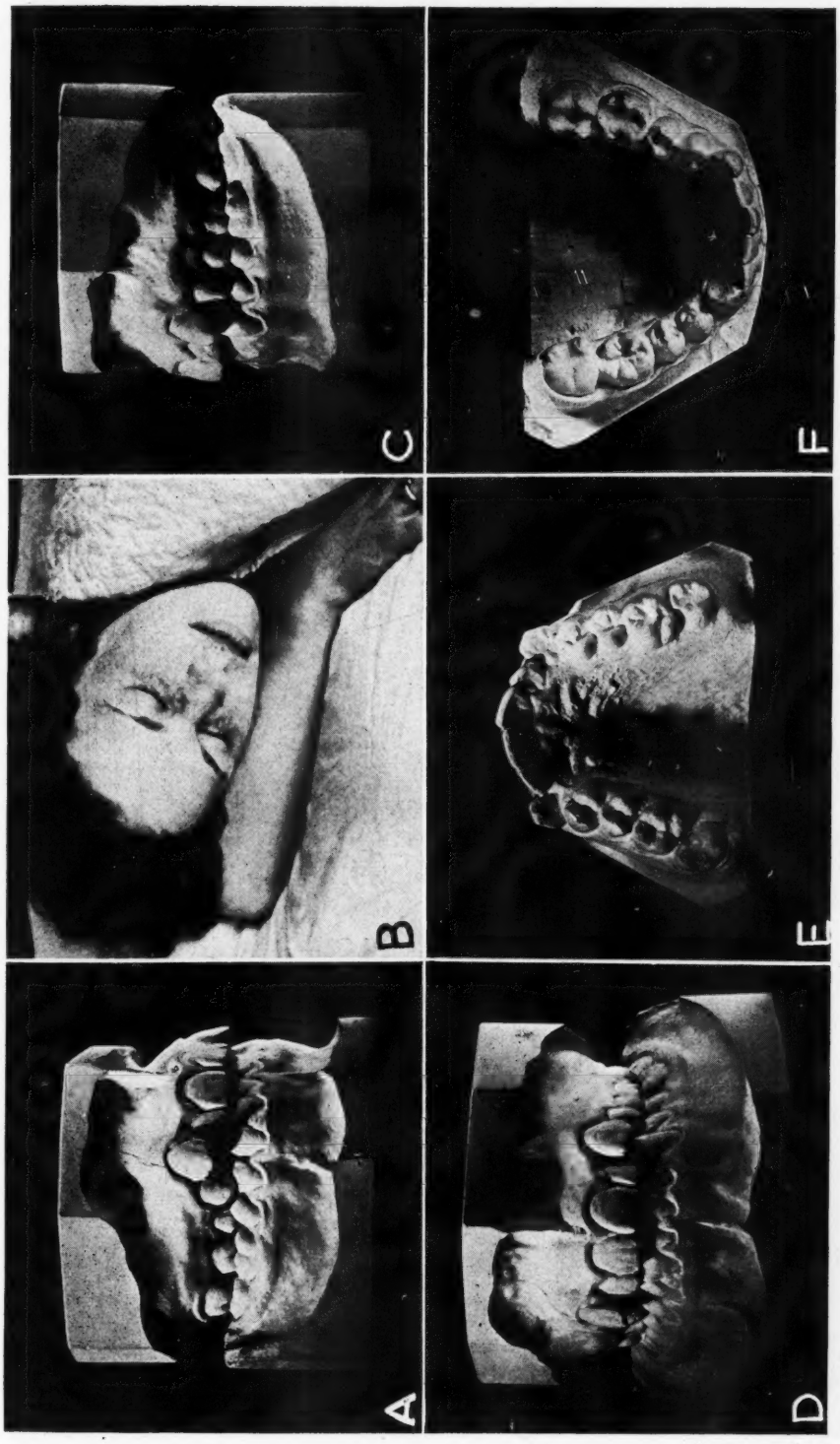

Fig. 4.

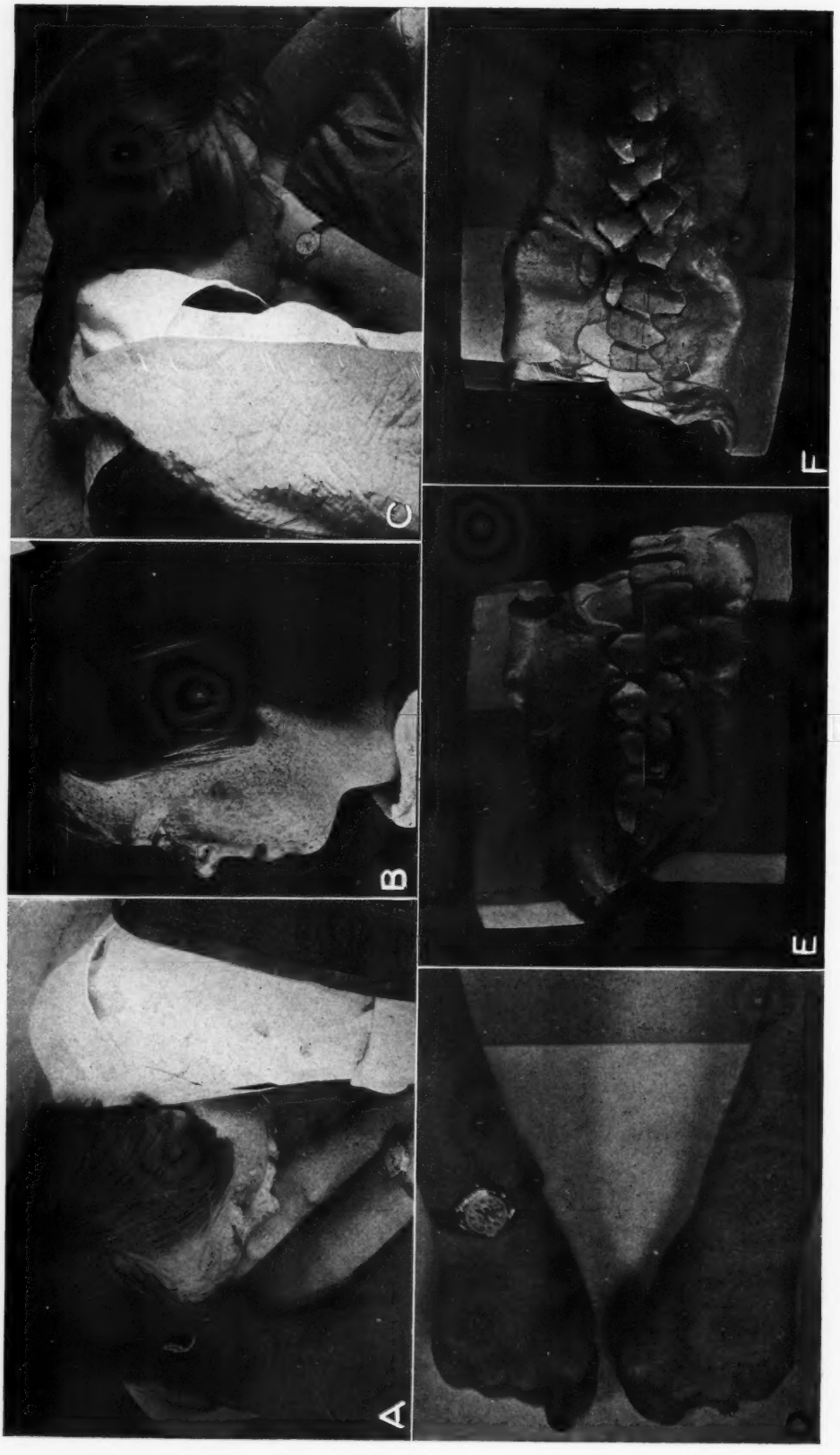

Fig. 5.

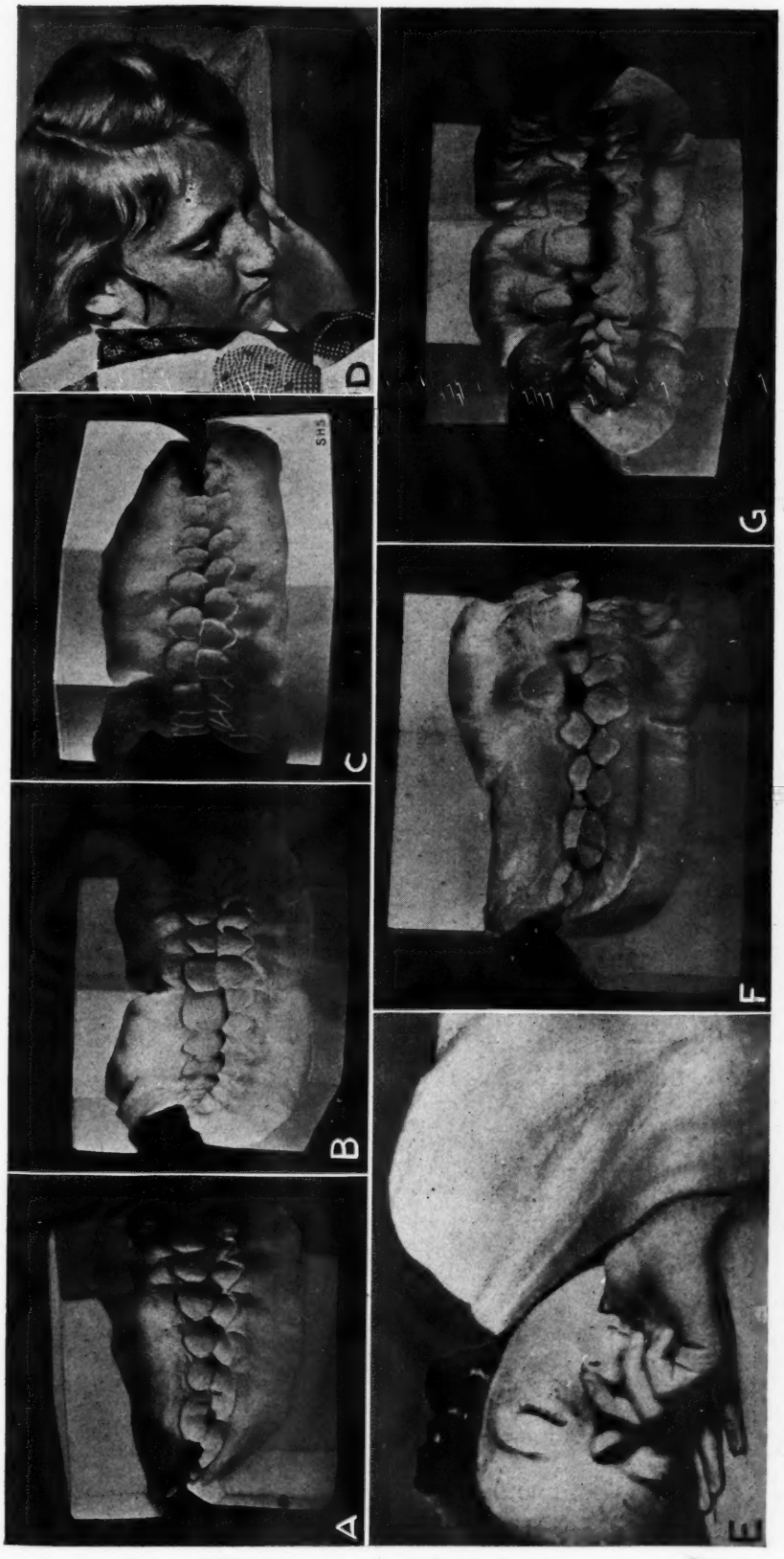

Fig. 6.

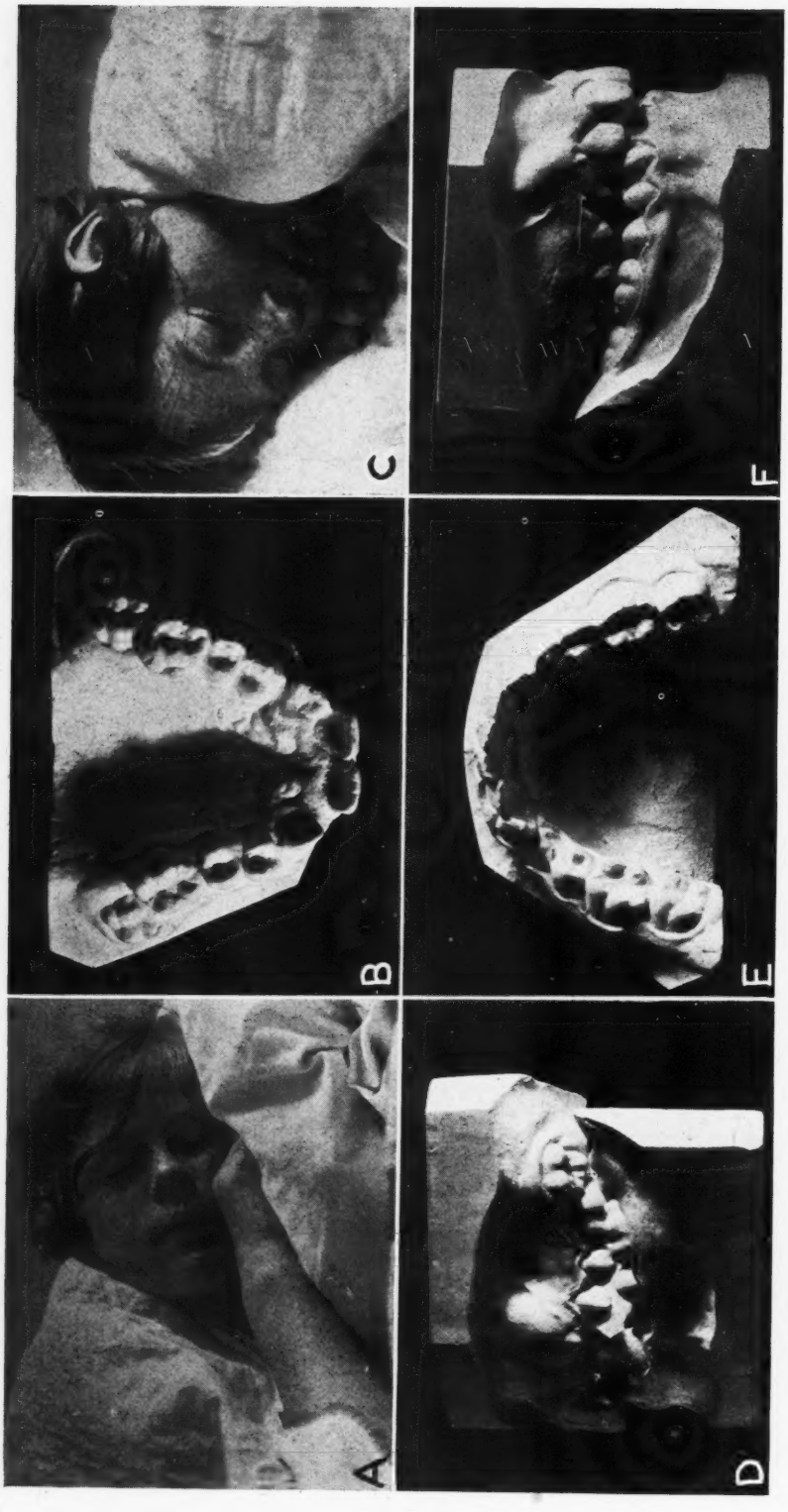

Fig. 7.

Fig. 8.

Fig. 9.

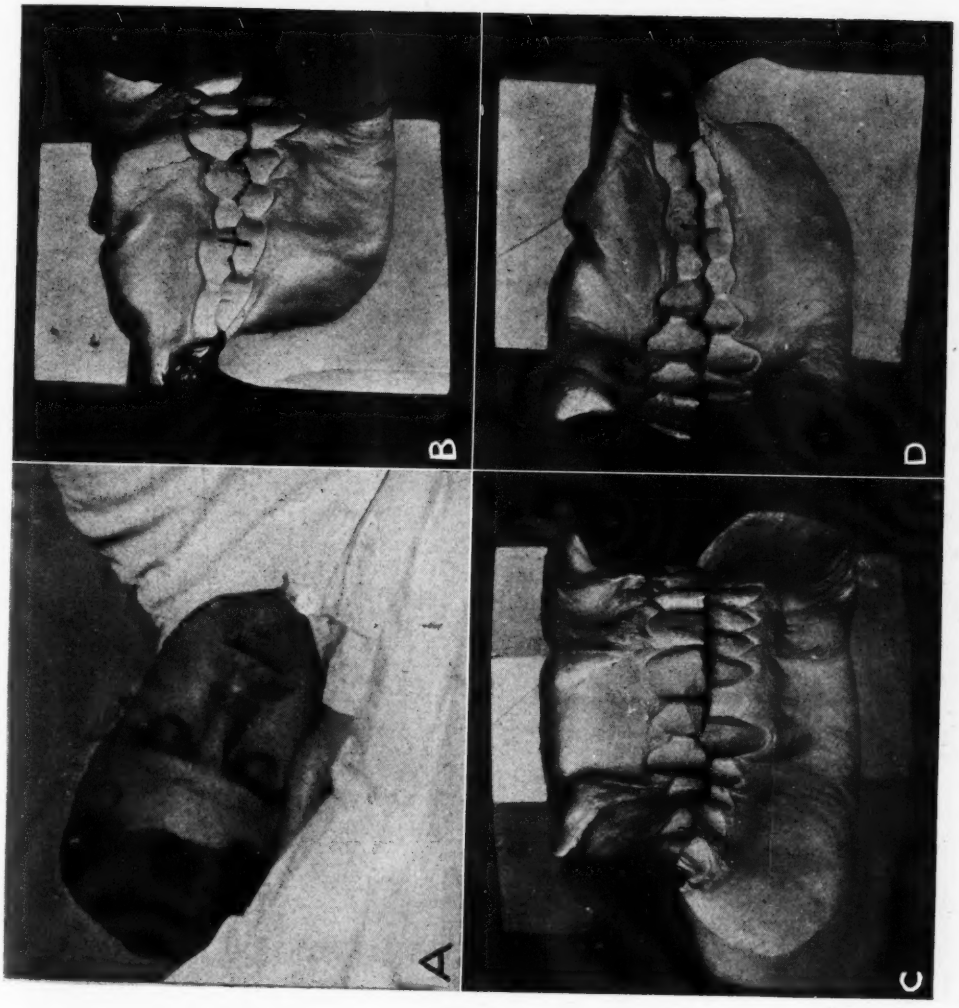

Fig. 10.

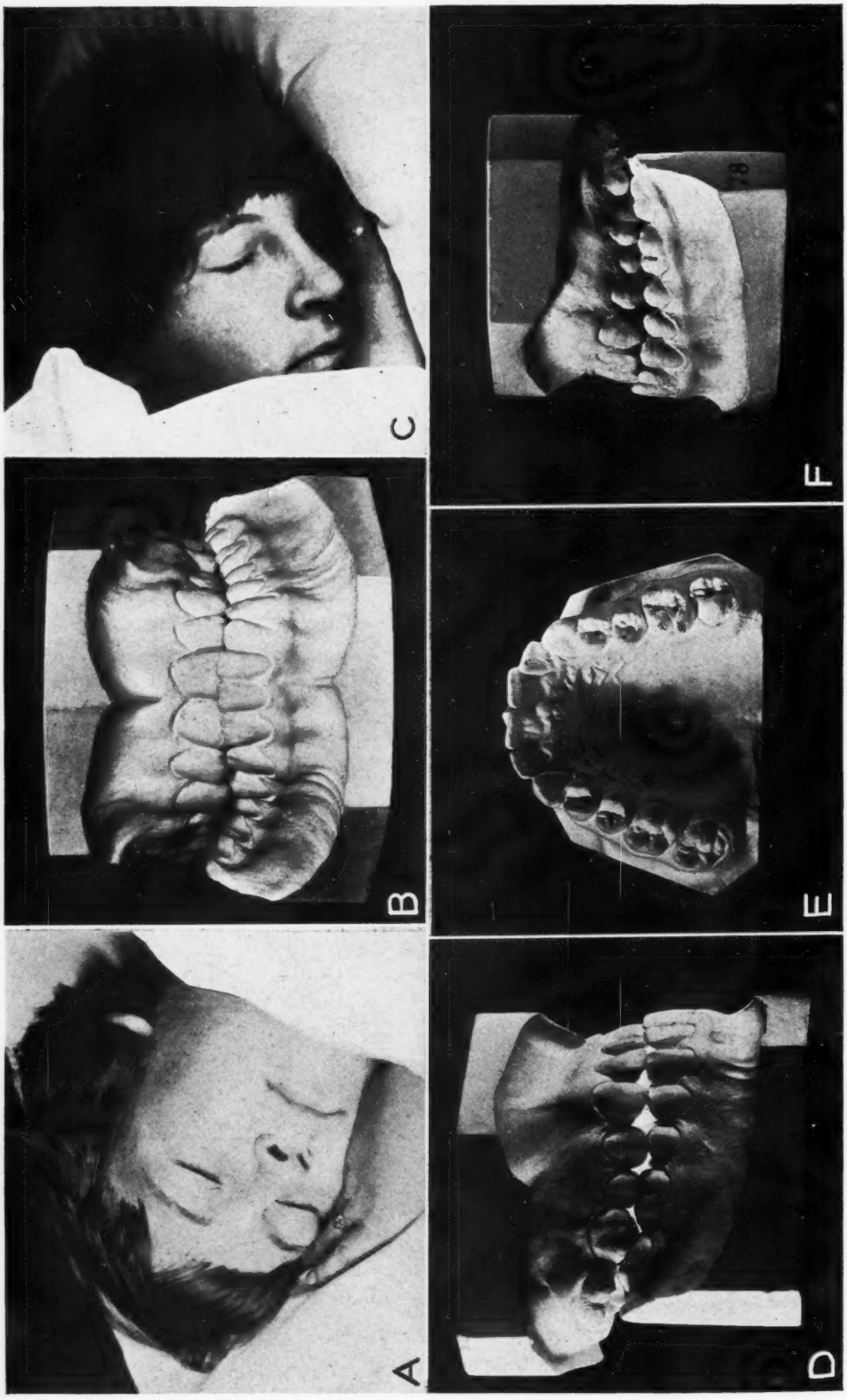

Fig. 11.

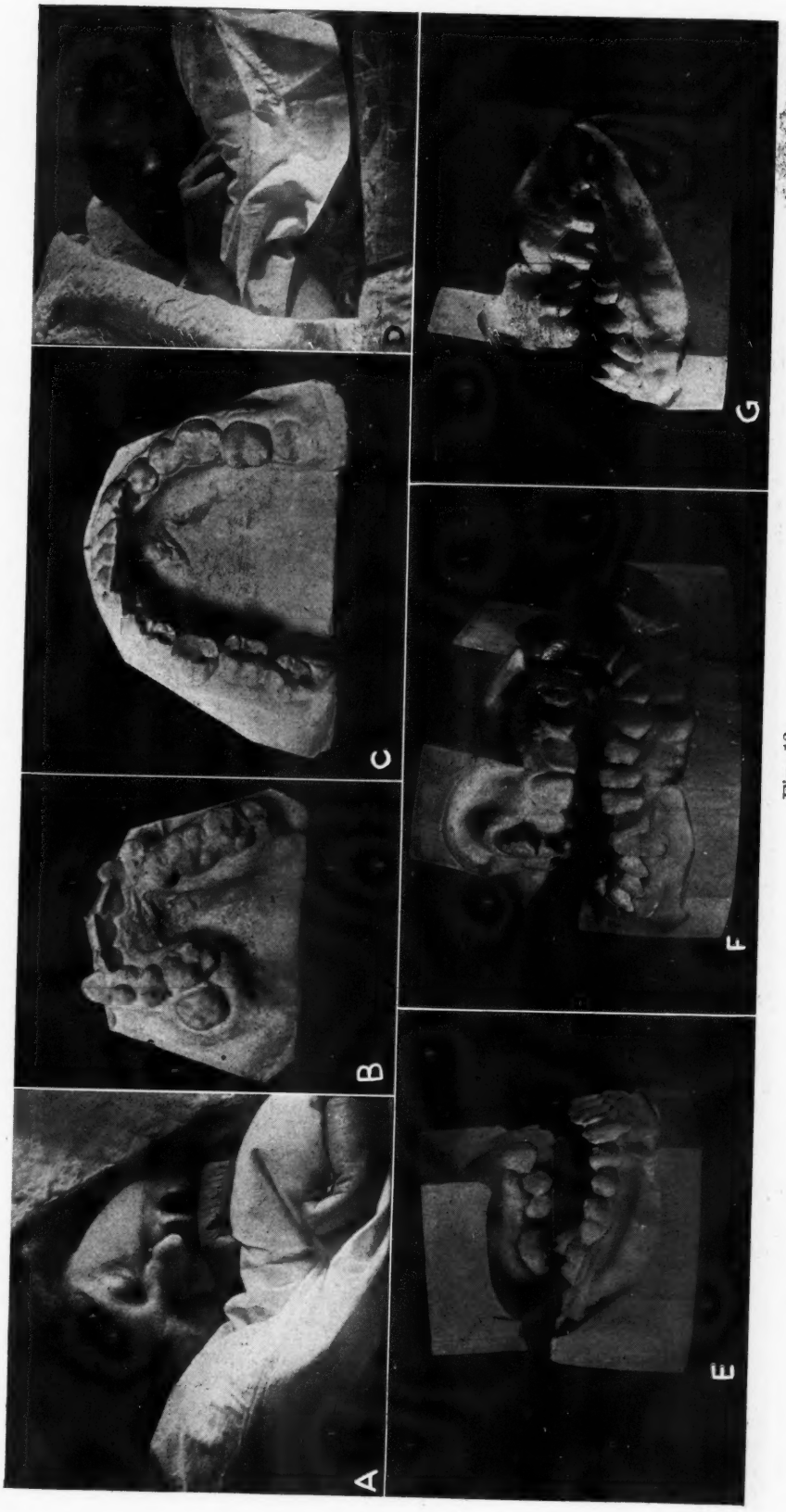

Fig. 12.

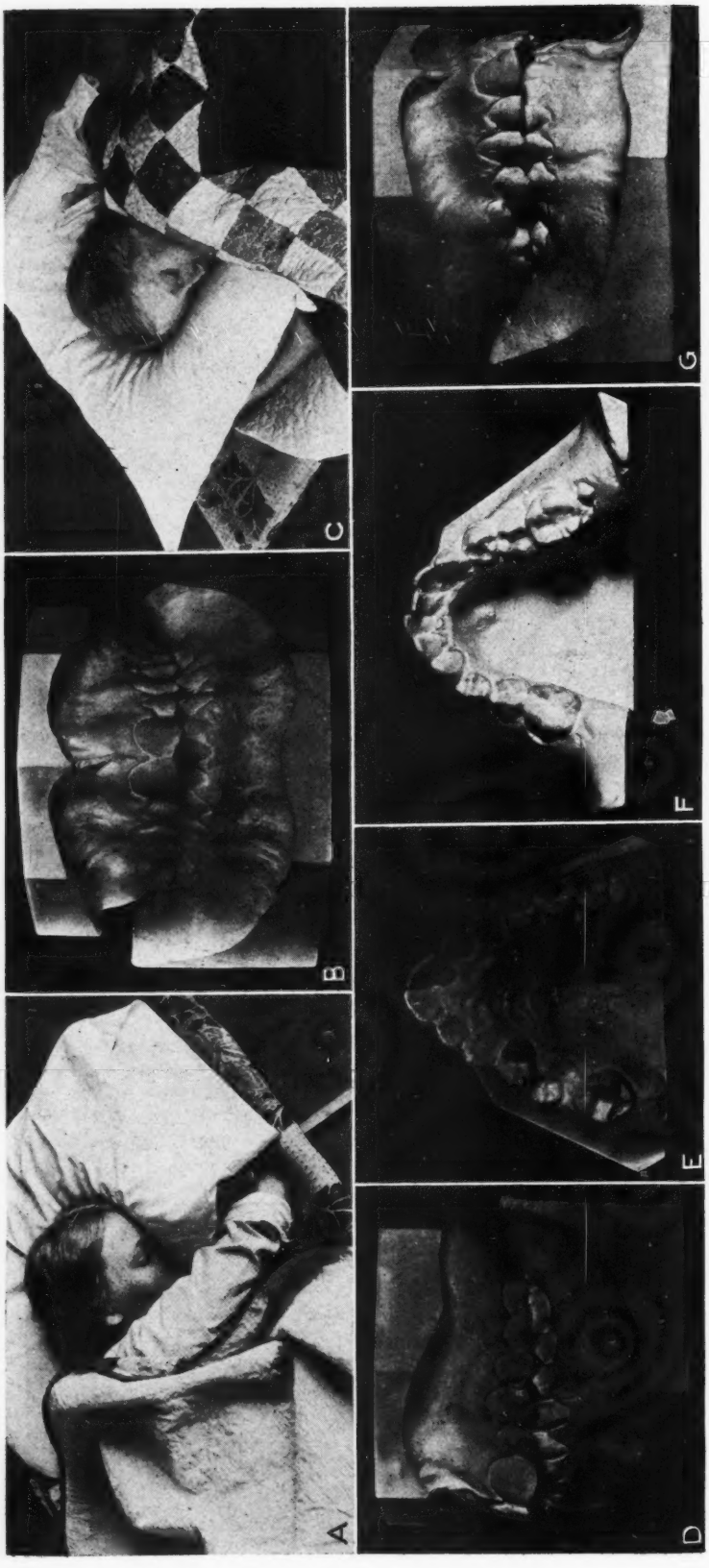

Fig. 13.

Fig. 14.

The malocclusion found and displayed in Fig. 13 has not been frequently noted by me, for it is one in which the maxillary arch is V'd much more than the mandibular. There is little distal occlusion; the maxillary teeth seem to protrude most in the front part of the mouth. She has practiced the habit of crossing the forearms under the pillow and resting the cheeks against the bedding. Part of the time she has used two large pillows. (Dr. Ottolengui will recognize this as an illustration used in Dr. Evangeline Jordan's book on children's dentistry.)

In the profile picture of Fig. 14 one may see what a splendid occiput (*B*) a child with a badly deformed face may have. He has been a face-sleeper from infancy, as may well be confirmed by the rounded, fully contoured, posterior portion of his head. Many mothers soliciting the services of an orthodontist are proud of the well-developed backs of their children's heads which they have under the advice of their pediatricians cultivated by keeping them from lying on their backs.

When I first presented the extraoral theory as an explanation of the development of malocclusion, I was then convinced that the upper jaw was the principal one influenced by sleeping positions, although the first case I ever studied was that in a child sleeping with his fist behind the mandibular angle which I believed accounted for his unilateral mandibular protrusion. I made this deduction because of the fact that the maxilla is fixed to the head and, unlike the mandible, was and is unable to move away from the object exerting the pressure. But Dr. Lourie, who has been a persistent, negative and, therefore, a useful critic of my ideas, said that the mandible should, if either jaw was affected, be more subject to deformations from such causes than the maxillary apparatus. I had already studied the child in Fig. 15-*A*, *B*, *C*, *D*, *E* when Dr. Lourie made this remark but did not dare use this illustration, since the child had lost so many teeth prematurely which would compel me to assume that early loss of deciduous teeth has little influence upon determining arch length and expansion. Later, after many observations in school examinations, I have found that gross malocclusions of all sorts exist in children who have lost no deciduous teeth. Hence in Fig. 15-*F* and *H* are displayed the cast of a child having all his teeth and the same sort of malocclusion associated with a similar habit. This malocclusion has been found in children at the age of four years. *G* is the cast of the mandibular arch in which are shown the teeth knuckled inward.

In Fig. 16 are the faces and casts of children who have maxillary contraction and mandibular retraction, a mouth deformity occurring so frequently in pediatricians' practices that I have named it "Pediatric's Malocclusion." The magnificent developments of the posterior crania suggest that these children have seldom, if ever, slept upon their backs. It has been difficult to explain the apparent forward positions of the maxillary teeth in similar malocclusions. I have suggested that the face has a certain amount of growth energy. Under proper metabolism the face will grow a certain amount. If it is constricted on the sides only, the energy is spent in a forward direction. My correlating of prominent occiputs with malocclusion is not new. Talbot noticed it and suggested that in modern human development the tre-

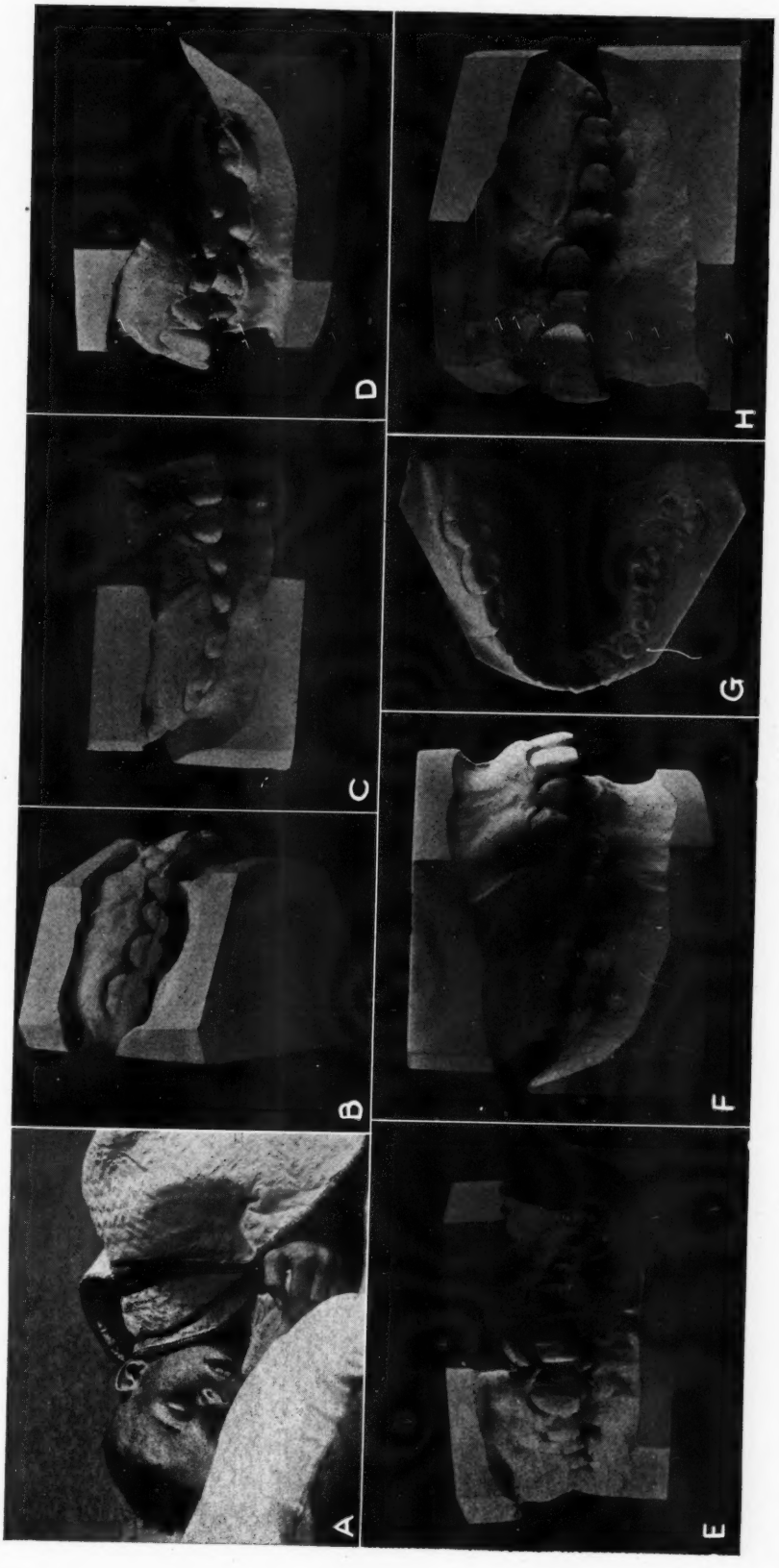

Fig. 15.

mendous brain growth absorbed the growth energy of the face. Hippocrates noted and recorded that dolichocephalism frequently accompanies malocclusion. The youngest child (*A* and *B*) is only eighteen months old. The face of the child in *F* was photographed after the teeth were corrected by Dr. G. P. Mendell. The cast (*E* and *G*) shown was taken at the beginning of the treatment. The treatment of this four-year-old child and its publication were used by Dr. Angle to prompt orthodontists to begin treating children at such youthful ages. I have not checked upon the case lately, but I am informed that it ended in failure.

In those cases where the mandibular teeth occlude inside the maxillary arch, as in Figs. 15 and 17, there is present a type of malocclusion seldom discussed and to which no common name has been assigned. For purposes of conversing with lay people I have termed this type the "inbite." The inbite on a side of the anterior portion of the mandible is often opposed on the other side of the jaw by a distal relation. The subject shown in Fig. 17 adds light to the mystery of such unilateral mandibular retraction which has been formerly explained by conjecturing that the child had labored breathing, during the eruption of the first permanent molars on that side, but easy respiration when the molars erupted on the more normal side. The persistent habitual leaning of mandible on a propped hand, as has been noted and recorded by several orthodontists, is undoubtedly a force of malocclusion in weary children made still more plastic by metabolic deficiencies.

It has seemed to me that, when children during convalescent periods sit with the chin resting into the palms of propped hands which in turn are supported on desks or knees, they increase the overbite by telescoping the mandibular arch in its anterior part into the maxillary arch, creating the attraction emphasized in the casts of Fig. 18.

I have read with interest the quarrels about gnathostatics, but I have accepted it for what it is worth. These models are better than unrelated plane models. Gnathostatic models are improvements; however, I believe that measurements therefrom must be interpreted and that treatment should not follow automatically upon line or plane determinations. Gnathostatics has aided me to view mouths in three directions instead of two.

Fig. 19 shows the casts and the leaning habit of a boy who slept upon his arms under the pillow part of the night but during a long year of convalescence sat with mandible resting upon palms of propped arms. In this gnathostatic cast can be noticed the great amount of maxillary attraction, a characteristic not easily demonstrated by plane models and static cusp relations.

To pediatricians who object to disturbing children by teaching them sleeping postures at birth which will not repress or distort their facial growth, I have said: "If I believed that the mouth was the only organ harmfully distorted by face-sleeping during infancy, I might be willing to allow physicians free range in advising facial pillowing. Furthermore, if it were necessary for the best development of the whole body to sacrifice the mouth, I should still be willing to make no protest. I believe, however, that the mouth

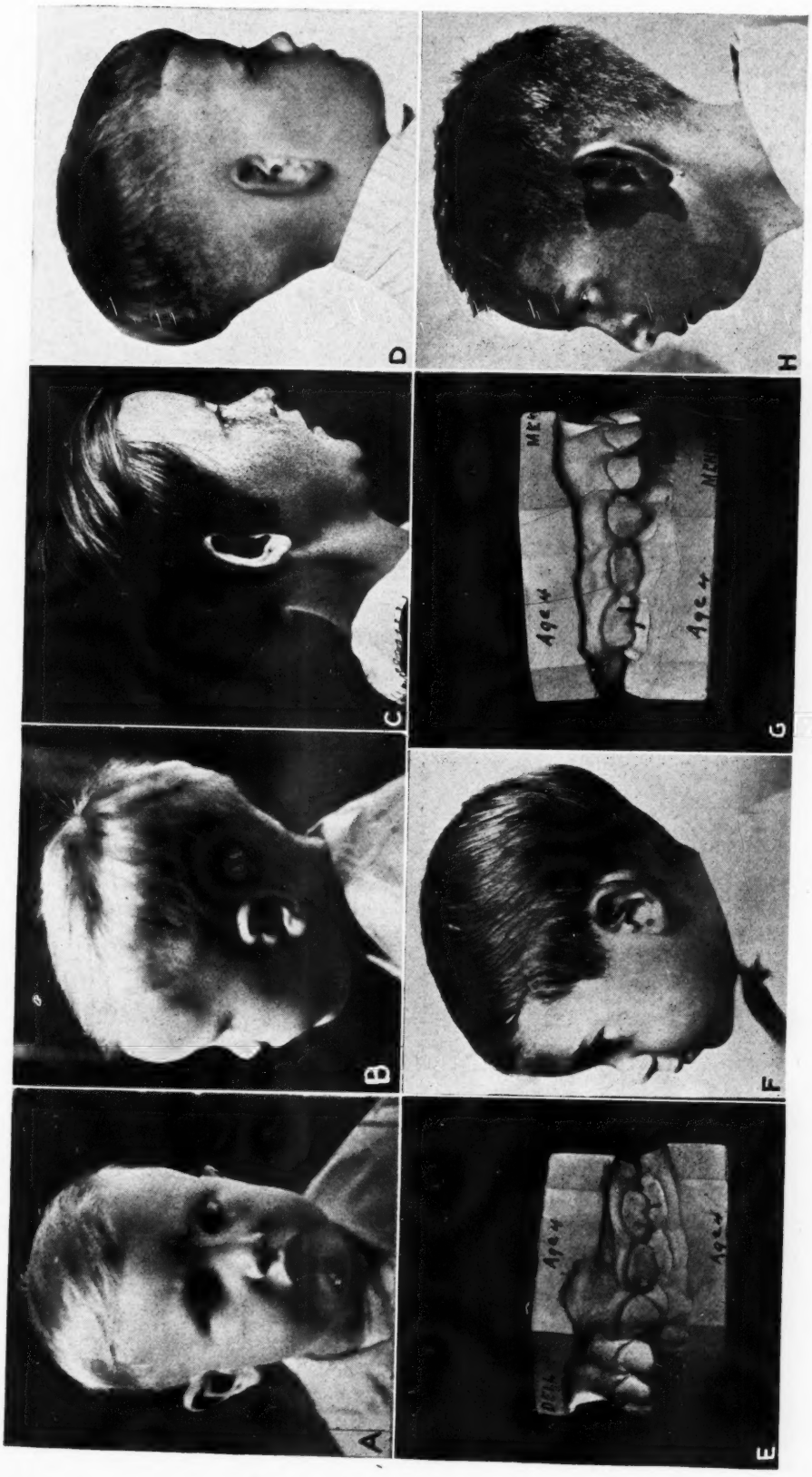

Fig. 16.

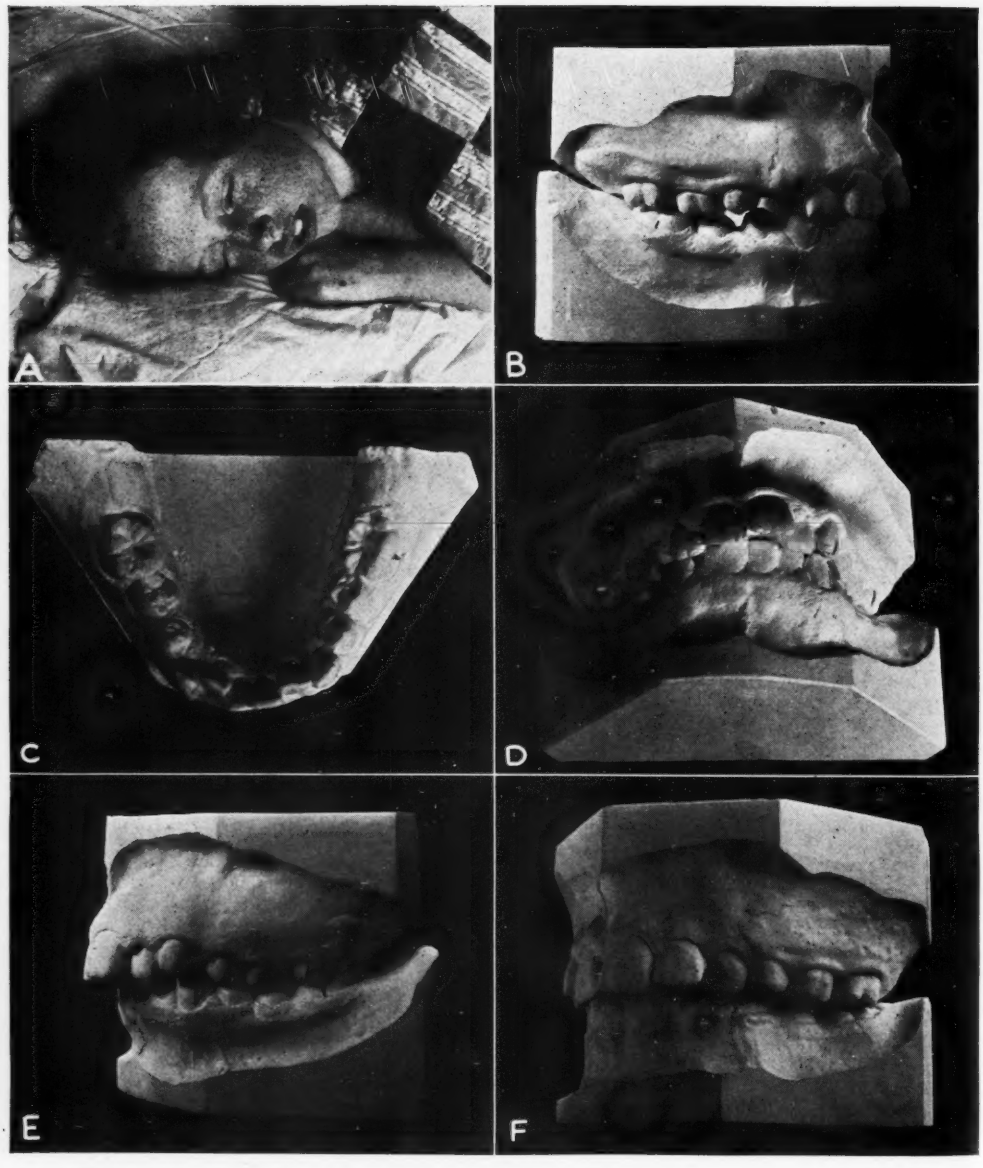

Fig. 17.

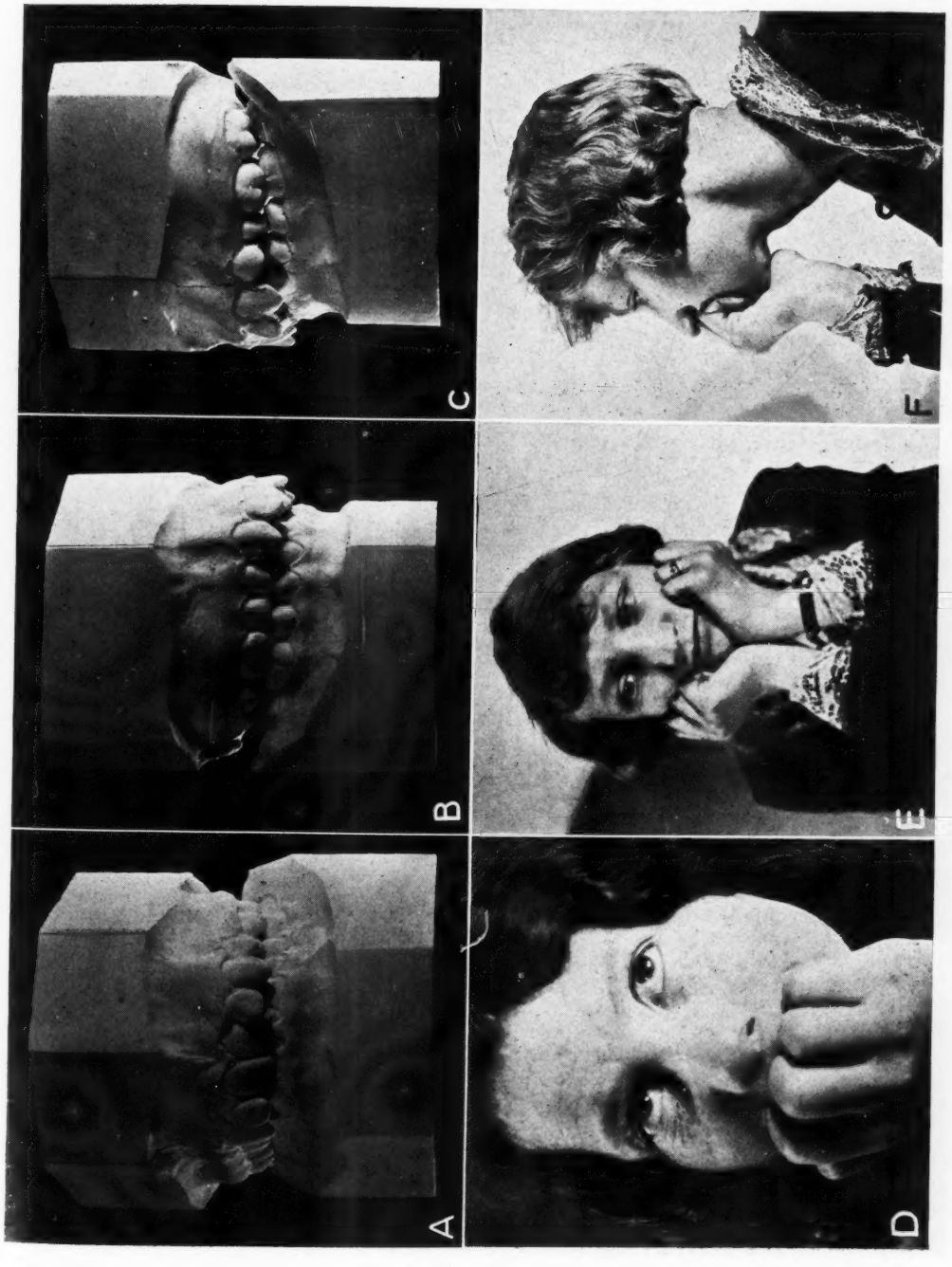

Fig. 18.

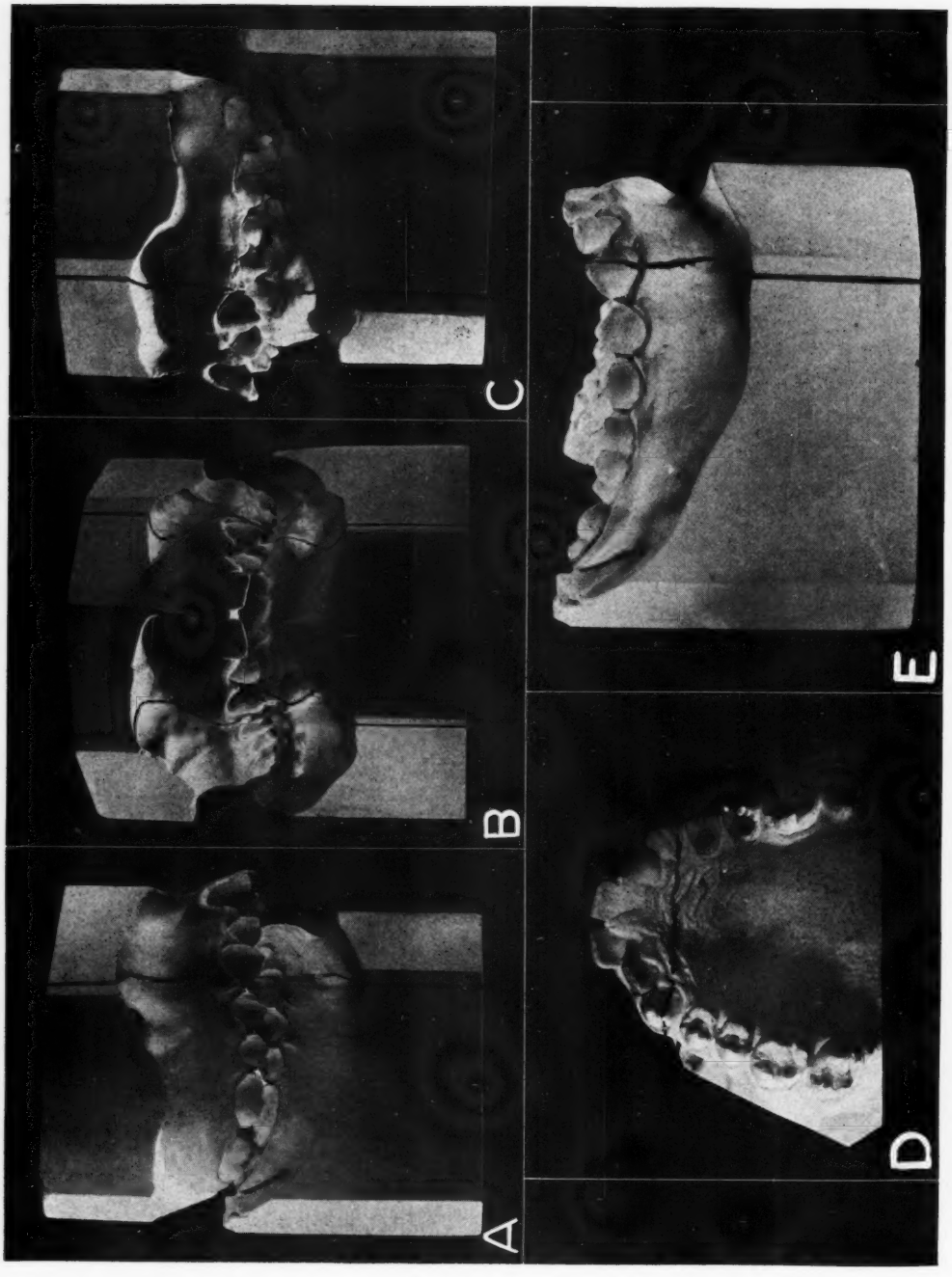

Fig. 19.

Fig. 20.

is like most other organs of the body and cannot be made to assume its fullest development without making the body as a whole grow, but more particularly its associated parts."

I have noticed that, in people who have habitually slept on the right side of their faces, their noses run leftward, and I suggested some time ago that the deflected septum—where there is no history of trauma—might be due to the fact that the patient slept on the right side, and as the face grew downward it was directed leftward. Thus the septum's deflection represents, accordingly, the path of the downward and leftward growth. Hence, if the mouth is deformed by face-sleeping, we may be certain that there will be companion deformities in the nose (Fig. 20).

In studying a number of Indian skulls housed and arranged in the San Diego Museum, I have been impressed with the frequency with which flattened and asymmetrical occiputs occur in such skulls. Anthropologists claim that such flattenings as that exhibited in Fig. 21 are unintentional. Note what well-arranged teeth accompany such cranial deformities, even in *G* which lacks a right lateral incisor, apparently a congenital deficiency. The skull in *E* has been sawed off so as to show graphically the extent and amount of the cranial asymmetry.

Fig. 22 contains pictures of the facial portion of a skull having typical Indian features which was found about 25 feet below the surface in the vicinity of Los Angeles. You may note that it has malocclusion typical to the modern forms herewith displayed. This skull is of particular interest to me because the subject evidently ate hard foods. This, it seems, discredits somewhat the claims that the chewing of hard foods is the main prerequisite for mouth development. In *E*, *F* and *G* are shown the maxillary casts with cross-sections of plaster casts made of the parts of the upper extremities causing the deformities. You will note how the maxillary indentations in arch alignment seem to have been swaged through the cheeks by these objects.

Continuing the study of body deformities caused probably by sleeping positions, I selected a boy about sixteen years old who slept and had teeth as represented in Fig. 23. I had him strip his trunk, take his sleeping positions, different sitting and standing postures so that I might study and record any postural irregularities. Such are shown in Fig. 24. The relation of the spinal curvature in the various postures can be noted. In *J* he is standing as erect as he can with great effort, while in *I* he is assuming his relaxed standing posture. From these two pictures, it may be shown that most of the deformity is still functional but adapted to the daily postures he takes but will become anatomic eventually with age, provided corrective measures are not instituted. Regardless of whether he rests his face on the right or left propped hand (*G* and *F*) he retained essentially the same curvature of the spine in the dorsal region. I made a plaster cast of his chest from which I made a cross-section tracing and later drew the lines shown in *C*. I erected at the center of the transverse diameter of the chest a perpendicular line which passes through the right side of his sternum. To the transverse I drew another perpendicular line through the center of the sternum so that the difference in space between these two lines might show graphically the asymmetry of his chest. No doubt,

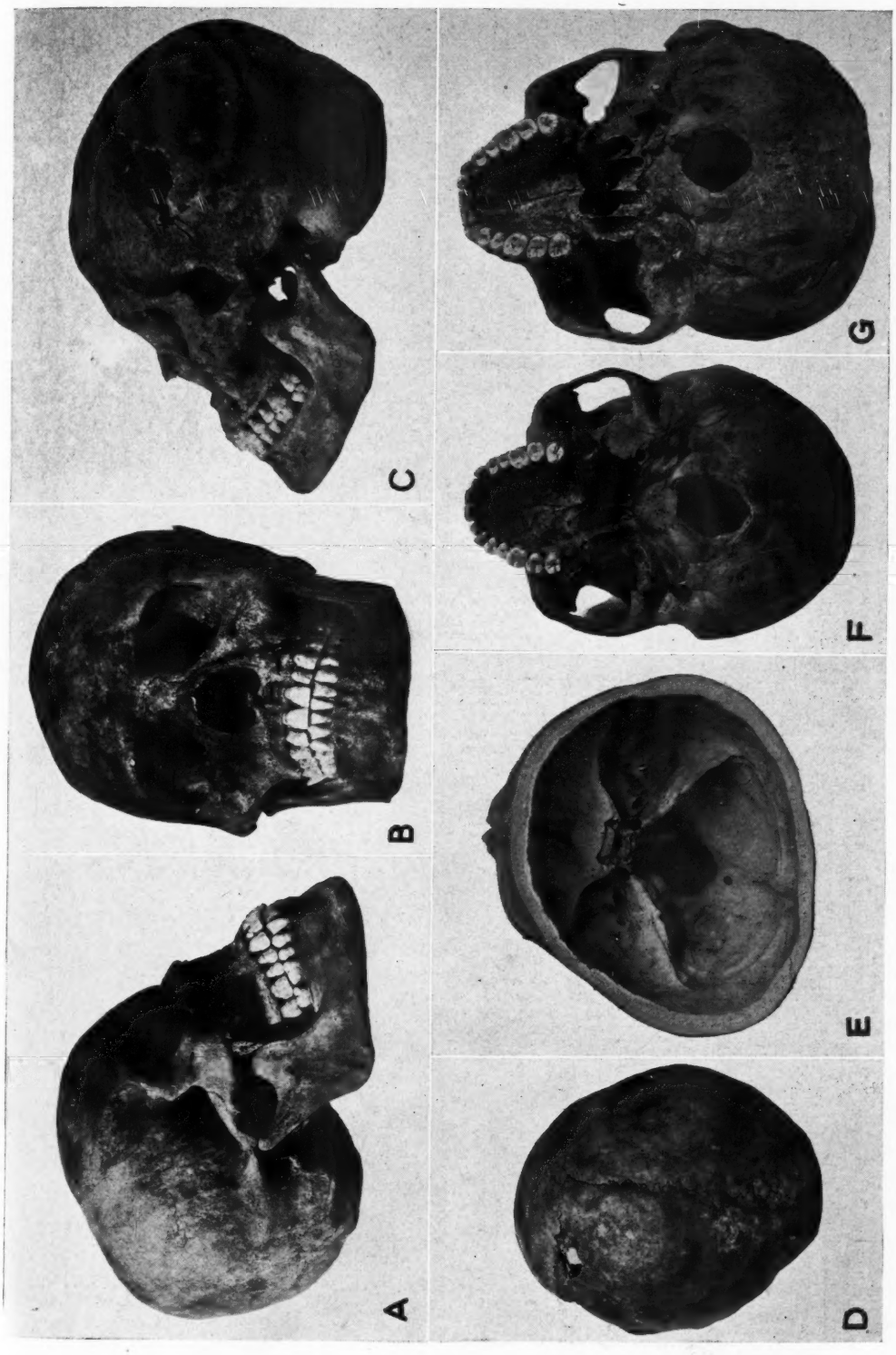

Fig. 21.

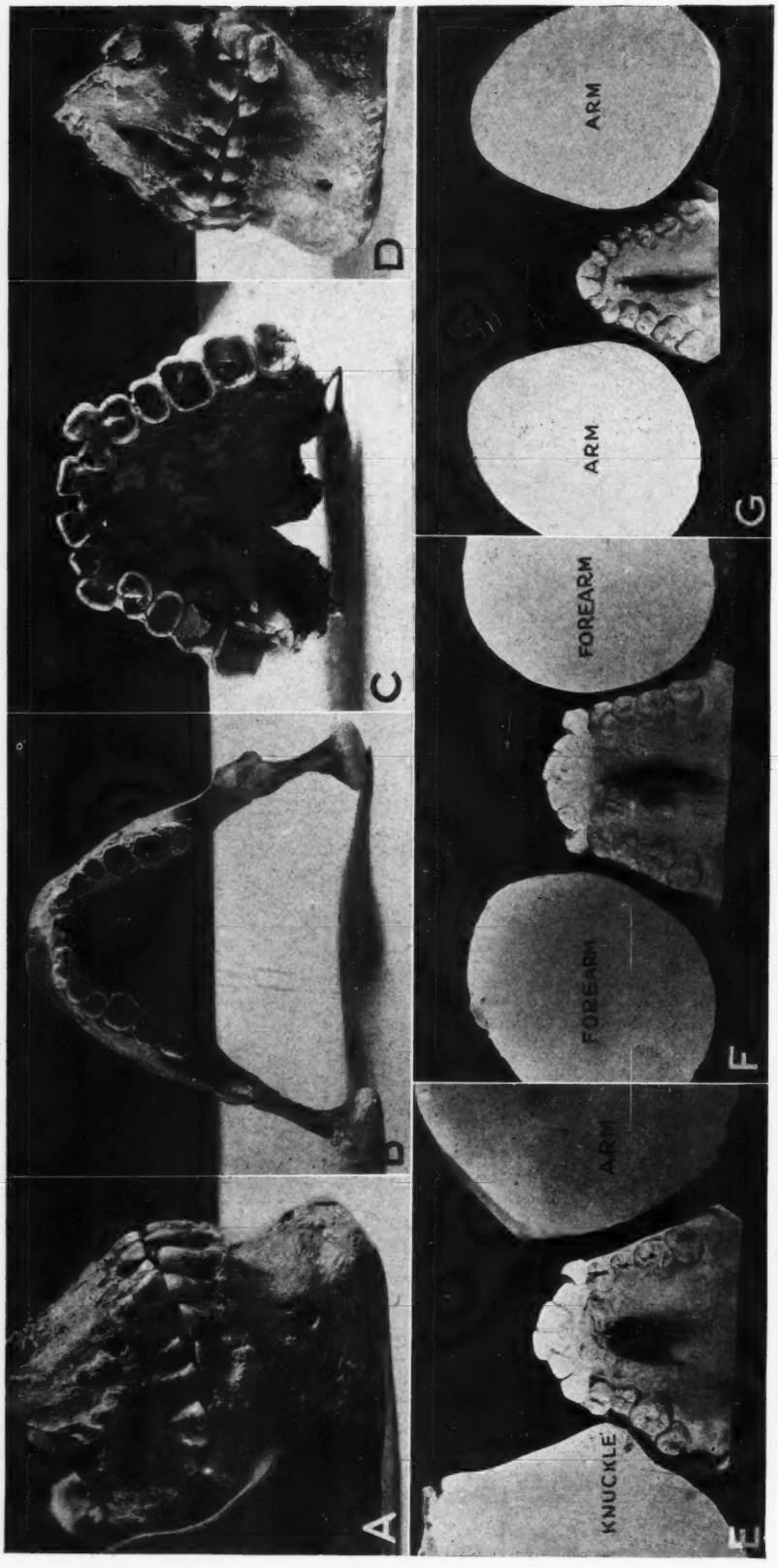

Fig. 22.

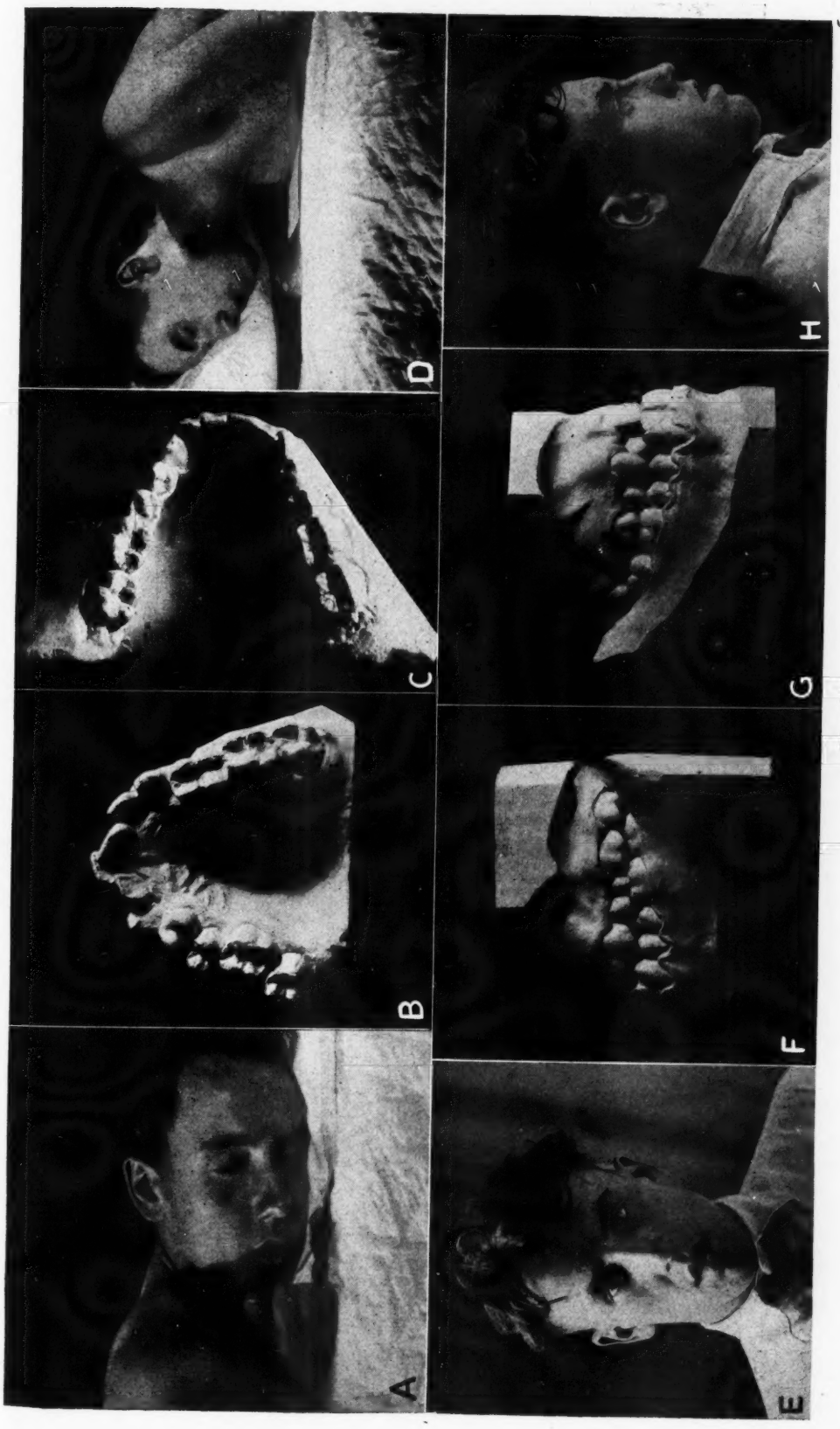

Fig. 23.

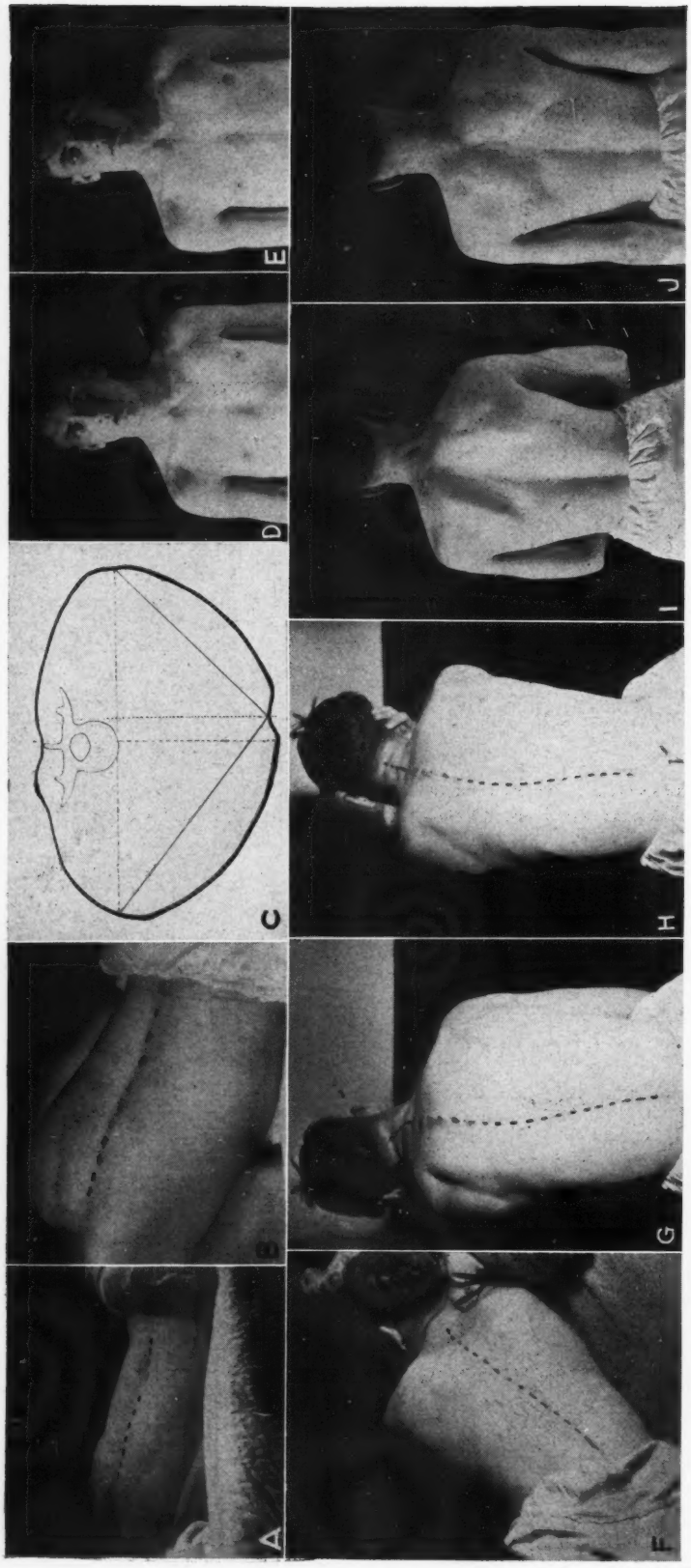

Fig. 24.

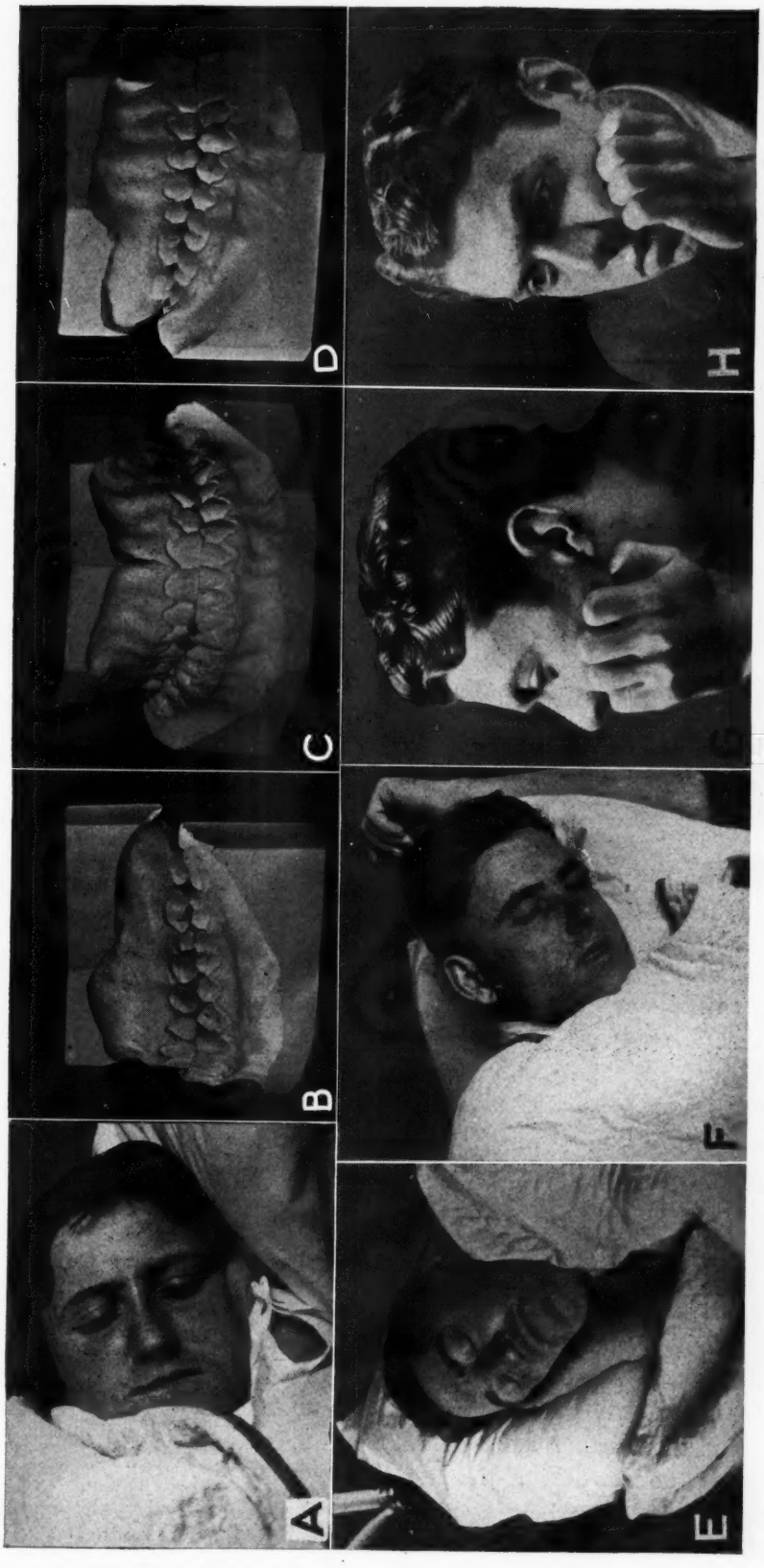

Fig. 25.

during his plastic childhood days, he flattened his chest by lying for long periods habitually on his right chest (*D* and *E*). The asymmetry of his chest and the curvature of his spine are thus correlated clinically with his facial deformity.

I have not been able to find many subjects with protruding jaws, but altogether I suppose I have studied about 25 such patients, and I have found that many of them have habits of pushing forward at the angle of the mandible as shown in Fig. 25.

In order to review the various forms of pillowing on parts of the upper extremity, I shall show by charts the various forms in sequence from the shoulder down to the fingers. *A* of Fig. 26 shows the shoulder position which might under various circumstances produce a cross-bite, a maxillary saddle constriction or a bimaxillary constriction, depending on how the shoulder contacts with the face. The habit here illustrated is such that it affects both arches but the maxillary the more (26 *B*). Its present or its past existence can be ascertained during mouth examinations in mixed dentitions by the inlocked mandibular and maxillary lateral incisors with prominent canines but with inverted premolars and prominent first permanent molars. The molars are less inverted because not much pressure can be exerted upon them by this habit. *C* shows the form of a habit which produces the typical even but extensive saddle-shaped arch. *D* (see 23, *B, C, F, G*) represents a habit which produces an irregular contraction of the maxillary arch. The pillow varies in its density and thickness; the cheeks also vary in their thickness and firmness as we pass from the mouth backward; then, too, the eruption of the different teeth takes place at different intervals of growth. The first molar receives the pressure first; hence, it is subjected to the influence longest with exception of the lateral incisor. The canine is influenced the least in time because it usually erupts last.

E represents the use of the forearm above the pillow but can be practiced with the arm hidden beneath. *F* represents a habit in which the face rests on pillows which are stacked on crossed forearms. *G, H* and *I* show various uses of the hand and arm combinations. *J, K* and *L* display various common habits of resting the corner and side of the denture on the back of the open hand.

A and *B* of Fig. 27 exhibit habits in which the hands are stacked with the pillow rolled between causing pronounced pressure against the face. *C* is a habit in which the palm is under the pillow beneath the face; *D*, the back of the hand under the cheek between pillow and face; *E*, the knuckle against the cheek; *F* and *G* show how the backs of the hands and fingers can contact with the face when inserted between the pillow and the denture. *H* is a form somewhat like *E* but distributes some pressure to the mandible; *I* shows the hand against the zygomaticomaxillary region; *J*, the stacked hands directly under the face; *K*, the palm against the maxillary arch; *L*, a habit in which knuckle pressure is brought against the maxillary and mandibular teeth contracting both and retracting the left half of the mandible.

A of Fig. 28 shows how pressure may be directed by the hand against the mandible to produce mandibular contraction (the inbite) and opposite retraction. *B* is a form in which the influence of thumb-sucking cooperates

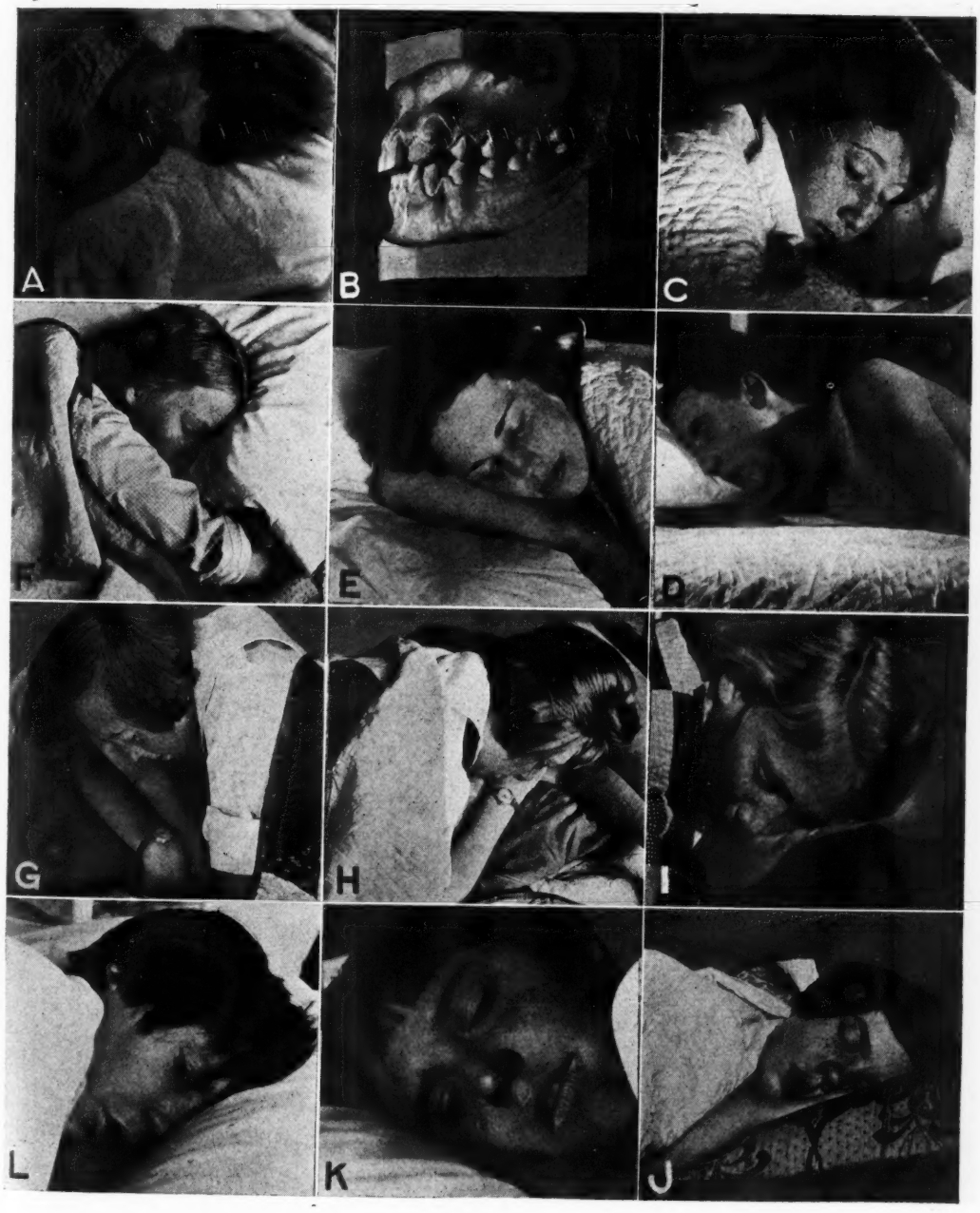

Fig. 26.

Fig. 27.

with pillowing on the back of the hand. *C, D,* and *E* represent pillowing directly into the bedding with, in case of *C,* the hands obscured by the pillow. *F* is the most effective habit in producing a unilateral inbite. The various habits exerting pressure against the angle of the mandible, all exerting forward pressure and tending to make the mandibular angle more obtuse, are shown in *G, H* and *I.*

In Fig. 29 are shown the various devices which have been used from time to time by human beings to control the sleeping positions of children. In

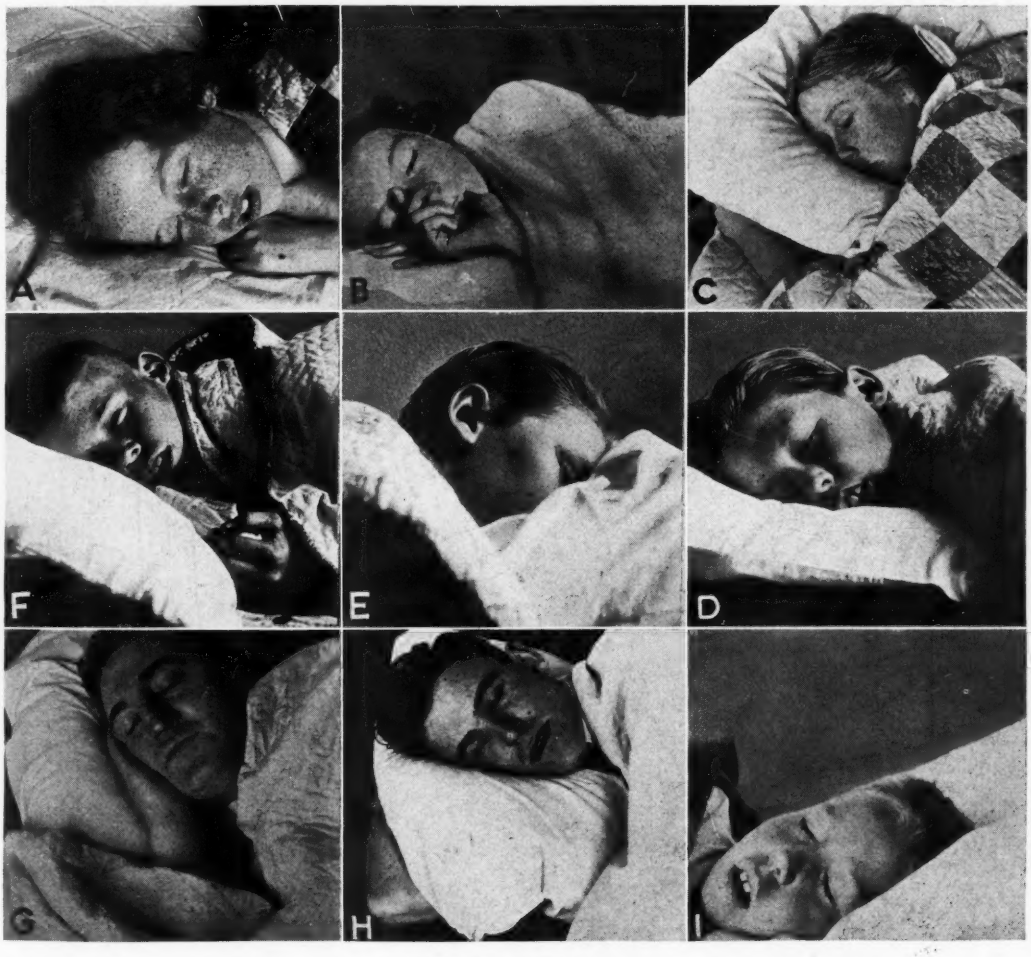

Fig. 28.

talking once with a native of Greece and again with an Indian Chief, I had offered to me an explanation for their cradle customs, namely, the fact that such would straighten a crooked leg or spine and train the child not to sleep on its face. Apparently these were contributory and secondary reasons to the general convenience of having the child ready for immediate mobilization, necessary for nomadic tribes. *E* and *F* show a modern gown suggested and devised by Mrs. S. E. Watson which will control the sleeping positions and habits of children who have already acquired these habits. The gown will permit three positions, namely, back and either side. The jacket keeps the child from sucking parts of his hand if the sleeve is buttoned to the basal

portion of the horizontal strap. It has been successful with children who will submit to its use, but many mothers will not submit to its use, because they think it is cruel, to which I have replied that I can think of nothing so cruel and inhuman as orthodontically harnessing up the teeth and moving them about only to let the treated case fail through negligence or by a return to pressure habits. I still believe that such a jacket is not so cruel as they suppose.

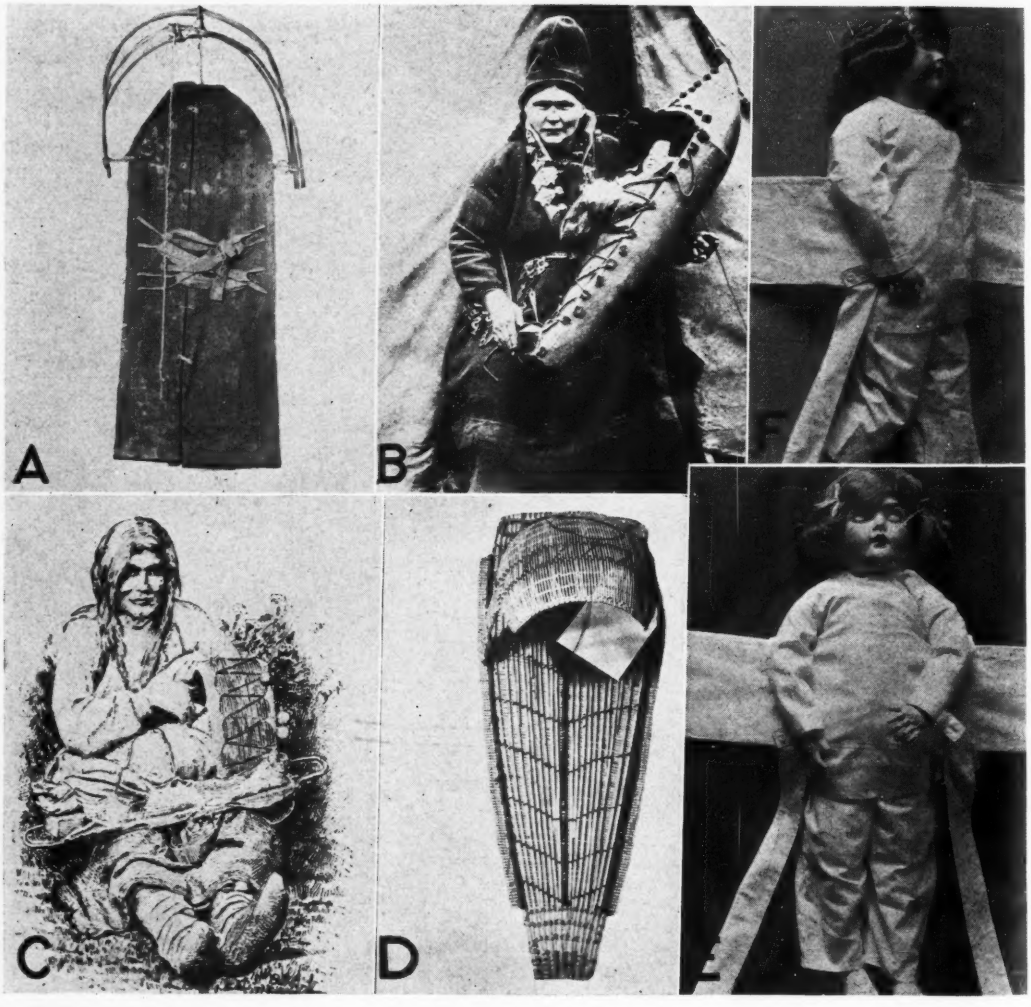

Fig. 29.

DISCUSSION

Chairman Young.—I think you will agree with me that we have enjoyed this paper, and I hope it will have free discussion. I think there are points that could well be brought out in discussion. Please do not all speak at once. I do not intend to call on anyone, but I say the floor is open for visitors as well as members to discuss the paper.

Dr. Fisher.—May I ask a question Does he think children who assume the postures that he has shown us maintain those postures throughout a night's rest? Further, has he ever taken into account how many times a child will change its posture during the night, and also, if a man slept on his hand all night, could he use that hand next day?

Dr. R. Ottolengui.—I want to ask him how in the world anybody ever gets straight teeth. I also want to ask, has he found it a fact that these postures of children produce identical conditions, because if not, then they are only an occasional factor. Unless it is a constant factor, it is not a true factor. Unless the result of a given cause is practically always the same, the cause may be looked upon askance.

Dr. Mershon.—I do not want to discuss it because I have nothing to say, but I do feel that Dr. Stallard has gone into a subject which we are vitally interested in. Dr. Ottolengui took the words out of my mouth. I was going to ask the question as to how he accounted for hundreds, and thousands, and millions of what we call normal dentures, and what kind of acrobats those youngsters must be when sleeping.

Dr. Jack Ross (Brooklyn, N. Y.).—I have a case very much on the same type. The upper arch is triangular and the lower is almost normal. I watched this girl for about six months, and she said she had no sleeping habit, but she seems to be doing something like whistling.

Dr. Shapiro.—I should like to ask Dr. Stallard whether there has been any study on the reciprocal effect on the part of the extremity involved in the habit; when the arm is used, or the wrist and knuckles, and the habit is pernicious enough to cause a malocclusion, there must be some effect on the part of the arm used. I wonder if it has been noted.

Chairman Young.—He cited a case which he diagnosed from the metacarpal bones.

Dr. Crosby.—I want to express my appreciation of Dr. Stallard's work. I have been very much impressed with the articles he has written in the journals, and I had one case in particular that gave me great satisfaction after reading about the asymmetrical deformations.

It is the case of a young woman twenty years of age who had a Class II subdivision. The teeth were in distal relation to the left lower, and I expanded the arch and brought the centrals forward, and had used intermaxillaries for a year and a third or a year and a half, but they did not budge, and finally I asked this young lady if she slept on her stomach and she admitted she did. I said, "You have got to quit it."

She said, "I couldn't."

I said, "You can if you will take it in the right way and not make a chore of it. All you have to do is say that you will not do it because it is good for you and the right thing."

She said she would do it, or rather that she would try. She went home and tried, and in three weeks the teeth were cusp to cusp on that side, and in six weeks they were in the right spaces.

I had her wear the intermaxillaries for three months longer, and they have never gone back. That proves to me that the hand under the pillow was the cause of the trouble.

Dr. White.—What is the correct position for a child to sleep in?

Chairman Young.—I have been extremely interested in this paper, and I hope that every one of you, particularly the younger men, when it is put in print, will read it carefully and think it over. I cannot help but feel, however, that Dr. Stallard has probably gone to the extreme, and I will not say he has reached the point, but it would almost seem that he has reached the point, where he attributes practically every malocclusion either to external pressure habit or to interference with metabolism.

That last phrase "interference with metabolism," is a very large one, and he may be quite within his rights when he does that. I think some of you, who were in Philadelphia about 1912 when there was a joint meeting of orthdontists and rhinologists, will agree with me that the late Dr. Cryer proved beyond the shadow of a doubt that there was no relation between the dental arch and the nasal chamber.

Dr. Stallard would try to impress upon us that practically all these twisted septums are due to external pressure. I cannot see it. If you wish, I will tell you what Cryer showed. He had two skulls. One had the maxillary laterals entirely lingual. The canines were in contact with the centrals. It was an arch about that shape [indicating with hands]. He covered the skull, and he said, "You, gentlemen, think by widening the upper dental arch you can widen the floor of the nose. I will prove you cannot do anything of the kind. If you did that, you could produce an osteoma. Now, can you do that? Look at this dental arch. What kind of nose would this be? Very narrow, of course." He took his thumbs away, and in that skull I could place my thumbs that way [indicating].

He had another skull with an arch like that [indicating a wide arch], and he said, "Look at it." He had the openings covered. "What kind of nose is this? A broad nose." I could not put my little finger in that way [indicating], it was so narrow. He said, "You have got to go further. You have to consider something else besides the nose and the mouth."

He said, "Look at the antrum." There was one as big as that [indicating] and the other about the size of a hazelnut.

Now, please, Dr. Stallard, do not think that I am belittling what you have done, because I am firmly convinced that orthodontists who will very conscientiously consider what you have given here this morning will have far fewer relapses in their treated cases and will be far less likely to fail in getting results.

He spoke of Angle's idea of the causes of malocclusion and the mouth-breathing, and so forth. It seems to me mouth-breathing must have an effect. The normal place for the tongue to rest in a human being developing normally should be against the roof of the mouth.

Study the normal cases that develop without any mechanical interference, and you will find a beautiful place for the tongue to rest when the mouth is closed. I do not mean that the teeth are in occlusion, because I think the teeth are in occlusion a very small percentage of the time, when we are chewing, and only at the end of the masticating stroke because when there is food there, they are not in occlusion, and people in repose have not their teeth in occlusion; therefore, the wonderful beneficial effect that has been advocated by function in the positioning of the teeth, I think, is almost nil, as Dr. Stallard has brought out here today, but let us take the human being, as Cryer said in that talk, and you feel that you increase nasal breathing, and you do, but not in the way you think you do.

The child must have sufficient air in order to sustain life. Now then, if you cannot get sufficient air through the nose, there is one other method and that is to open the mouth and get it there. If the dental arches are not sufficiently large to accommodate the tongue and the tongue is pressed against the nasopharynx, it occludes the air when the mouth opens. The tongue drops away, and there is a slight tensing of these muscles and that tends to narrow or at least prevent normally wide development of that maxillary arch.

There are so many things that enter into the causes of malocclusion that we must not think if we find out what are the external pressure habits and eliminate them, that we have the whole thing under our thumb, because we have not.

I am satisfied from my observation that perverted axial stresses can influence the position of the mandible. The mandible is a movable bone, and it will slide away from a tooth when it first erupts. Teeth on eruption are not nearly so well able to withstand heavy pressure as when the root is fully developed, so I think that enters into it.

Then Dr. Stallard brings up the question of the rotation of the teeth and describes that these teeth may be rotated depending on the pressure. I question that from the bottom of my heart. I believe every tooth that erupts in the human mouth in a rotated position had the tooth germ in a rotated position when it first started to form.

I have heard people claim that by interference of hard spicula of bone the teeth could rotate during eruption. I will concede that that is possible, but very, very improbable. That is all I have to say.

Dr. Stallard (closing).—Perhaps I should begin by answering first the last questions asked. I have a friend in Los Angeles who says we know nothing about heredity, otherwise we would not be paying $50,000 a head for blooded bulls. Because, if we did, we could select parents and produce them directly without waiting to try their offspring. There is nothing that we know so little about as the heredity of human beings.

We make a serious mistake when we confuse familial characteristics with hereditary characteristics. It is a well-known fact that malocclusions are quite often familial, but that does not prove that they are hereditary. However, if a man wants to take the easiest course, he may assume that malocclusions are hereditary. If he wants to conduct his practice blindly on that line, I wish him good luck. But I do not believe it is rational, nor is it the right attitude even toward heredity.

How does the hereditarian select his evidence? I am not speaking of the men who specialize in such work but of the laymen contending that certain things are inherited. They

find similar characteristics in related families. They make no measurements of these variations; they are not cognizant that such may have a nutritional or environmental origin; nor do they have any standardization of the similarities with which they deal.

Similarity, as they test it, is largely by imaginative or subjective means. If the hereditarians will measure the objective factors of similarity and determine the subjective interpretations of these, they would have a little fairer attitude toward heredity.

Sometimes I epitomize my attitude in heredity by saying that the finest deciduous mouth I ever saw was in a sister of the patient having the worst malocclusion I ever saw. Now, I would not use that as a line of evidence to disprove the possibility of heredity in malocclusion, but that is the only type of evidence that most hereditarians have. Such is an unfair attitude toward heredity.

In dealing with this whole problem of the etiology of malocclusion, I mentioned in the second paragraph of my paper that there are two types of abnormal variations: (1) those resulting from environmental factors; (2) those in which we have never been able yet to find a factoral correspondence. I tried to cover the problem of heredity so that you would not catch me on it.

Chairman Young.—Very foxy!

Dr. Stallard.—With regard to axial stress, there might be something to it, but we know of no way of determining its influence in maldevelopments. Formerly I believed it held an important part in the etiology of malocclusion, but a larger experience has modified my belief, as I shall show later. It occupies a very important place in treatment, because you must upright the teeth to make them take the chewing stresses in a proper way, but that accomplishment will not save your treated cases from relapsing if there are other more powerful factors of maldevelopment at work. Since it is a therapeutic necessity to establish a proper axial stress, orthodontists have projected this therapeutic influence into their etiologic thought.

However, as Dr. Watson pointed out to me, if axial stress is not a factor in the worst types of malocclusion, then why should we emphasize its all-importance in the etiology of simple forms?

In regard to rotated tooth germs, I believe what Dr. Young has said is very true, but he is an extremist when he assumes that "all" rotated teeth result from rotated tooth germs which were embryologically rotated without any environmental influence. "All" is a little word, but it covers a lot. Undoubtedly there are lots of tooth germs that are improperly placed, apparently from no factoral correspondence at all, but in the saddle-shaped arches the rotations are so characteristic that I have been able to produce the same sort in artificial or human teeth set up in wax when I pressed against the plastic wax with a round object. So, I have been led to believe that the long-continued pressure might be responsible for bending the bone in which the crypts are housed causing the rotations of the contained tooth germs.

Chairman Young.—May I make one point clearer that I probably did not make clear enough in my discussion? I mean that a tooth when it erupts is in the position that the tooth germ started it.

Dr. Stallard.—I believe that is true.

Chairman Young.—I do not mean after it is in the mouth, erupted. There are any quantity of maxillary central incisors that rotate to their normal positions that are in malocclusion when they erupt.

Dr. Stallard.—Occasionally, you see it the other way, too. You have all seen treated cases relapse into forms that differ from their original malocclusion.

I talk frankly about my failures because 50 per cent of my cases fail in spite of everything I can do. Now, I usually consider a failure one in which the occlusion is worse a few years after ending the retention period than before the treatment. I have no hesitancy in speaking this way because, like Rousseau, I am no worse in experience than many other practicing orthodontists. I have not made a close check on my practice, but in it there is a high percentage of failures. If you can get 50 per cent of your cases to stay nice, you are doing wonderful work. One of the reasons, I claim, I want to stay in San Diego against the advice of some of my colleagues, is to be able to watch the old failures, doing everything

possible to keep in studious contact with my treated cases in order to learn more about prognosis. I believe it is the right thing to admit failure when it is present.

Regarding mouth-breathing, I scolded my wife very severely when she first suggested that all narrowed arches might be due to external pressure, because I said we have many other splendid ways of explaining the development of a V-shaped arch, basing it largely upon mouth-breathing, early loss of deciduous teeth, and perverted axial stress. Well, I would still believe that mouth-breathing might be of importance, did I not occasionally find some persistent mouth-breathing patient with an enormous mouth, hippopotamous-like. I realize that such might have had an oversupply of internal secretions, but then there are animals that breathe normally during distress periods through the mouth, and they do not seem to destroy their dentures very much, at least it has not been so recorded. I should say that mouth-breathing exerts practically no influence at all, except that quite often the child by mouth-breathing will allow the mandible to fall away from the external force and not be injured as much as otherwise.

In children having shoulder habits, whether they breathe through the mouth or not, they may have bimaxillary constrictions because in such positions the mandible cannot escape the pressure. In my earlier days in this clinical investigation I ran across a Greek who had not breathed through his nose very much because his posterior nares were nearly closed at infancy and were left uncorrected until he was thirty years old. He had wonderful occlusion, as nice as I have ever seen. I mentioned this instance to Dr. Lewis, a Los Angeles rhinologist, who confirmed my observations by his own experiences.

You know, exceptions do not prove the rule. Whenever you bump up against an exception, you have to modify your rule to include the exception, so I should say that we have greatly overemphasized mouth-breathing as an active factor. Perhaps it is a passive or an incidental factor but certainly not an active one.

I did not quite finish my talk on heredity. Of course, the things I encounter which are thought to be inherited are things about which we know nothing. I lump all the biologic unknowns into the hereditary class, which we have always done. So, in the matter of missing maxillary lateral incisors, I find that it runs consistently in some families. One of the most distinguished families in this country shows missing maxillary lateral incisors in every generation as far back as we have a trace. The separation of the maxillary central incisors runs in families; other missing teeth, more particularly premolars and third molars, run in families. Whether such characteristics are familial or hereditary, I do not know. At least we have not yet found any correspondence they bear to environmental factors.

If we can find some way of explaining the mechanics and the symptoms of a hereditary case of malocclusion so that we can tell the nonhereditary type from the hereditary, I shall be more favorably disposed toward the hereditarians.

I do not believe that all malocclusions are due to external pressures. I believe that a child may have rickets so badly that just the weight of the mouth will distort it. I am led to this belief by Dr. Marshall's work on dog experiments in which he produced very irregular dentitions by doing nothing but feed the animals deficiently. However, he made none other than casual observations on how these dogs slept or rested, and I have been broad enough to take for granted that even they were not influenced by external pressures.

There is no doubt about lip-sucking causing certain symptoms of malocclusion, but I object to the Angle theory or philosophy that a child, by sucking a lower lip, could retract the teeth a bit so that chewing would through perverted axial stress develop an outrageous distal occlusion and maxillary contraction. I believe it is going too far with the lip-sucking theory, because this force is only a mild local factor. What I am trying to do is to evaluate properly the alleged factors and engulf them into a classification, listing those of environmental nature in one category and the pathophysiologic responses into another category. This is a more enlightened attitude than listing causes into an unorganized sequence.

Some here have asked about correct sleeping positions. Since the face is the terminal bud of the head, since the jaws are filled with teeth at birth and remain influenced by tooth eruptions until we are sixteen or eighteen years old, I have concluded that these parts should be kept free from external pressures. The face expands during growth two-thirds its size at birth, while the cranium grows less than one-third more after birth. Since the cranium is

badly distorted by sleeping upon it, a fact generally conceded, I have come to the conclusion that the face, which is more complicated in function, form and growth and which is never ossified to adapt itself normally to lateral pressures, should never be slept upon, especially in tender infancy.

If these large, thick, flat cranial bones, which ossify completely at an early age are distorted greatly by pillow pressure, it is a part of wisdom to keep children from sleeping on their mouths and noses regardless of their conditions. If they have colic, cure the disease. To expel from their stomachs the sucked-in air acquired during feeding, pat them gently on the back while holding them upright. Now, since physicians cannot diagnose metabolic disturbances until the child is in such a bad state of health that almost any one can recognize it, it is a part of precautionary wisdom to keep children off their faces during sleeping and sitting lest the deficiency diseases come unaware and unrecognized and predispose the denture to deformities.

Dr. Crosby mentioned the occasions of rapidity in treatment. Sometimes this seems to be effected by an absence of counteractive habit pressures. Other times you cannot explain it at all. Dr. B. Frank Gray asked me the first year I practiced, "How do you explain the fact that certain Class II cases will respond rapidly, requiring only a few months to treat them, and in other cases you never can establish satisfactory occlusion, even though the patients wear the intermaxillary rubbers and go through all the prescribed cooperation?"

Well, there might be external resistances in such failures. In fact, I have found that these cases which I cannot get in some sort of occlusion have either been chin-leaners or have slept on their faces or have held their jaw forward lazily so that the intermaxillary elastics were ineffective. I will not treat a case without using buccal appliances. At each visit of the child, I pull back the cheeks to note scars, which, if present, show whether the child is lying against the appliances. If they are, they must cease such voluntarily or else submit to a harness. It seems to me reasonable to assume also that the fast-treating cases are in those who have previously broken such habits and offer no resistance save the inertia of the tissues themselves. I have had saddle-shaped arches relapse in treated children in just a few weeks after a return to a habit.

Dr. Shapiro asked about reciprocal deformities in the arms and hands. I qu't publishing observations on such, because Dr. Harris McClain panned me so hard upon it. He said, "Man, you do not know anything about the arm and hand and their normal anatomy. You'd better cut that out." I still look for such variations, but it is true that I do not know enough about the hand and forearm to know what is normal and what variations are likely to appear in them. In taking his advice for the present, I am hoping some day to know enough about such variations to answer this question definitely.

Dr. Ross asked about the possibility of cheek-sucking causing the V'd arch. It would be hard to show that lateral suction could constrict the jaw beyond where the lips and cheeks habitually reach. I could conceive that it might constrict the jaws in the premolar regions, but before making even a tentative conclusion, I should want to know something about the length of time the habit is indulged and how strongly the muscles act. Other men have discussed the unlikelihood of such a factor. The late Dr. Talbot effectively argued that the cheeks are unable to produce on one side of the arch a V-shaped constriction and on the other side a saddle-shaped indentation.

Somebody asked me about similar poses making similar forms. I have already made that clear by stating that the position the child took can often be identified by the tooth arrangement, and, conversely, the malocclusion can be predicted by the position in which the child is found sleeping.

In examining children in rural schools, I look at the backs of their heads first. Dr. Watson accuses me of diagnosing malocclusion through the back of the head. You can, to quite an extent, predict the kind of arches you will find in a child by studying the back of his head. If you find a child having a great, big, pouting posterior cranium with no lateral flattenings, you are almost certain to find correlated with these features a Class II Division I malocclusion (pediatrics malocclusion). If you find the cranium distorted on one side or shortened noticeably, you are likely to find in the child good occlusion. However, since there

are many other factors responsible for head shapes, such as unfavorable birth presentations, etc., one must be careful not to generalize too definitely.

Some one asked how I accounted for the presence of as much normal occlusion as there seems to be. I have been agreeably surprised to find a considerable percentage of children in the high schools and the upper grades with nice occlusion. In such children I find also evidences in their posture and in the shapes of their back heads that they have not been face sleepers. Occasionally I find children sleeping with the face downward, but resting their foreheads on the crossed arms. Their foreheads may be rounded off at the corners but they lack oral deformities, hence a child may sleep on its stomach and, by propping its head via the forehead on the arms, allow the mouth to escape external pressure.

Dr. Fisher has asked about how long children would sleep on the hand at night and if they could use that part of the arm the next day. It is a fact that children having such habits will take these comfort positions and maintain them for two or three hours at a time. If you sit in the room next to them listening, you will hear their beds creaking and shaking whenever they start nesting into changed positions. If you, not having the habit, try to sleep with an arm under your face, you may not be able to go to sleep. It would be a punishment for you to keep it under your face, but these children have become used to it, and the habit is as thoroughly fixed as your own present habits of sleeping.

I have wondered often how people could sit for so long without having distress in their hips and spines, because I myself cannot sit very long without having "sleep" pains in my legs. But there are people who can sit for hours in cramped positions and have no perceptible distress. Fundamentally there is nothing stranger about sleeping upon an arm or a hand than sitting upon our thighs. Any part of the body used to sleep upon tires.

I sympathize with a disbeliever of this theory, because one of the earlier objections I had to external pressure theories of malocclusion was the fact that I myself could not assume any of these positions and induce sleep, having been a back sleeper or a left-side sleeper most of my life. I regarded it ridiculous to suppose any one could deform himself in such ways because I could not assume any of these positions and maintain them with any comfort.

Not long ago I noticed that an investigator from Yale had decided that the most efficient manner of sleeping for the greatest mental activity when awake was to sleep on the stomach. I surmise that the gentleman has always been a stomach sleeper, or at least for a long time. The doctor thoughtlessly recommends his habits to his patients. Recently a western professor has decided that the most restful way to sleep is "cuddled up into a ball like a kitten." I have not paid much attention to this because I surmise that he is recommending his private habit.

Particularly do I now want to thank Dr. Young for being so bold in his criticisms, because he has cleared up many points which would otherwise be hazy. Again allow me to thank you all for your interest and generous remarks and for your kind invitation to make this appearance before your society.

SOME THOUGHTS CONCERNING MUSCLE EXERCISES*

By Herbert K. Cooper, D.D.S., Lancaster, Pa.

DURING the last decade, much has been written about muscle training as an aid to or means for treating various malocclusions. The idea that muscular pressure influences the occlusion of the teeth and the development of bone is not at all new. We are all familiar with the forces of occlusion as given by Dr. Dewey which includes, as we know, muscular pressure; therefore, when considering muscle exercises as an aid to treatment, one must bear in mind that muscular pressure is only one of the six forces of occlusion. It is a known fact that all the forces of occlusion bear an interrelation with each other, and when an abnormal functioning of one of these forces occur, we find also other forces which are functioning abnormally. Nor is it enough to try to develop abnormal muscles in order to stimulate growth of bone and overlook a case of malnutrition which is also a causative factor in that malocclusion.

It must be remembered that the teeth are not held rigid in the jaws but are constantly moving under the stress of mastication; also that they are held in position by the forces of occlusion and are constantly changing position during the growth of the individual. When the teeth are formed normally and in proper occlusion and all the forces of occlusion are in balance, we find one of the most beautiful pictures in nature. The word balance is without question the most descriptive word in the preceding sentence because it is the lack of balance of one or more of the forces of occlusion that brings our patients to us for treatment.

The unique part of muscular pressure is the fact that it acts in conjunction with more of the forces of occlusion than any other of the forces. For example, when we find atmospheric pressure to be faulty, we also have abnormal muscular pressure. They are so closely associated that if one is faulty the other is sure to be. If we find obstruction or lack of development of the nasal tract caused by mouth-breathing, abnormal muscular pressure will result.

In the proportion to the exactness with which we discover the various forms of unbalance and correct them, will we determine our success in the treatment of our cases. We find quite early in our study of malocclusions and their treatments that we must deal with structures and forces.

We have learned that teeth were preceded by jaws in our evolution, and they in turn preceded jaw bone. Now the denture in which we are interested depends upon bone for the support of the teeth, and it is this bony support which we must change. Let us consider for a few brief paragraphs some of the high lights of bone which we try to develop through increased function.

We know that bone is not laid down or changed in any haphazard man-

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ner. It is true that bone can be changed in a given individual to best suit the demand placed upon it. It may be modified by stimulation in a definite orderly way.

We also know that the bones in which the teeth are set are not hard and unyielding like a post set in the ground, but are living, growing, plastic tissue composed mainly of lime salts. We know their structure, form, and function depend upon the stress they have to bear and that they remain constant only when there is an equilibrium of the forces that act upon them. If this equilibrium or balance is disturbed, the bone will continue to change, readjusting itself until equilibrium is reestablished. Recent studies in form as related to function have brought us to the realization that no case can be successfully maintained until normal function has been restored.

If normality and abnormality in function are factors in growth and development, then surely their influence should be given the closest study, since the jaw bone plays such an important rôle in facial contour.

We were clearly shown at our last meeting that the bony spicules are so arranged that when force, either mechanical or physiologic, is applied, the load may be carried with the least amount of bulk. Bone is ever in a constant state of equilibrium, ready at all times to meet the demands made upon it.

In the development of the bones associated with the teeth, and in fact of any bone, two of the important forces influencing the growth are cell metabolism and muscular pressure. The one big influence which holds teeth in their proper position is the musculature of the face. Even if we have a full set of teeth in perfect occlusion, with the teeth, arch, and face in their proper relation to each other, they would not remain in position were it not for the balancing effect of the muscles of the cheeks and lips. There is always the growth impulse of the maxilla downward and forward, and of the mandible upward and forward to be considered. Without the counteracting pull of the musculature, the teeth would move forward. Going back to our paragraph on bone modification, we can readily see that these forces must balance somewhere in the anterior part of the mouth or this forward movement would never stop. This tendency is seen in many of the lower animals.

The lips are the antagonizers of this force in the human denture. This muscular arrangement acts as a wide elastic band which surrounds the teeth and holds them in their places. The maxillary teeth overlapping the mandibular teeth act as a retainer, while the lower lip retains the maxillary teeth. In a normal denture the lower lip rests against the incisal edge of the maxillary anterior teeth. The mandibular teeth project into the mouth cavity and are supported there by the tongue. The tongue on account of its size and function as a leading organ of speech has played a great part in the evolution of the mandible, especially of the chin, to the back of which the tongue is attached.

So much then for the normal. Let us now consider the abnormal.

Rickets as a predisposing cause to malocclusion not only acts upon the bony structures but also has its effect on muscle tissue. Holt says, "In rickets the muscular symptoms are almost as common and as characteristic as those

of the bones. The muscles are small, very flabby and poorly developed. Their power is sometimes so feeble as to suggest paralysis.''

It seems to me that it is expecting too much from nutrition alone to correct this condition. With the aid of a wisely advised exercise devised to stimulate the muscle, a great help can be found in the treatment of the case. In this athletic age, when the benefits of physical exercise are constantly before us in some form, this can be easily explained to parent and patient.

Muscle cells degenerate from lack of use, and the only way to increase oxidation is to make them work. Whenever a partially paralyzed muscle contracts, it not only improves the nourishment of its fibers, but also the coordination of the nerves which stimulate it. Histologists tell us that muscles develop as a result of exercise or use and atrophy from lack of exercise and use. It is the application of this law to the treatment of our cases that gives us the balance which is needed to maintain the denture in its proper relation.

Malocclusion always accompanies long-continued mouth-breathing. If this condition is caused by enlarged adenoids or some other obstruction of the nasal tract, their removal is always advised. Many physicians believe that the clearing of the tract will make the patient a normal breather even if the mandible and teeth are in such position that the lips cannot be kept closed without muscular effort. This naturally renders normal breathing impossible.

It is not my intention to go into details as to the specific exercising method employed in treating cases. Rogers, Robison and Wilson and others have given us methods of procedure which if followed faithfully will help us solve many troublesome problems. It is more my intention to make a plea for a more thorough understanding of the forces which when acting normally will maintain the arches in their proper relationship.

There is no longer any excuse for inefficient mechanics in orthodontic treatment. Our dental literature is full of descriptions of very efficient appliances. After such a descriptive and instructive demonstration as given by Dr. Oliver on Monday, it seems that the treatment of malocclusion so far as mechanics is concerned has reached such an efficiency as is humanly possible to reach. But the orthodontist who confines his efforts to the most perfected appliances and yet overlooks any of the other functions or forces which act upon the denture is in my humble opinion courting trouble. The man who limits himself to the use of a so-called perfect appliance overlooks the fact that the denture and surrounding tissues have forces that if directed in the proper manner will spell success more quickly and permanently.

Muscle exercises as given by different pioneers on the subject can be divided into four groups:

1. Muscles of mastication.
2. Muscles of facial expression.
3. Muscles of deglutition and speaking.
4. Muscles of breathing.

The idea of muscle exercising having a direct effect upon the underlying bony structure is a sound one, but one cannot hope to get results by theories

alone. It is after all the practical application of that theory which must be adhered to.

The first thing of importance in starting a case is to be able to pick out the muscle or group of muscles which are lacking in their balancing effect. If a muscle lacks functional coordinating control, that is if it is not under the direct control of the will, one is perfectly justified in beginning the development of that muscle or group of muscles.

The unbalanced use of the muscles found lacking results in unbalanced development, which can only be corrected by excessive exercise of the unbalanced group of muscle or muscles and a lessened use of the overdeveloped group of muscles or muscle. In other words, there should be a concentration upon the unbalanced group only. Any system of muscle exercises which stimulates the whole musculature without singling out the weak or unbalanced one is liable to do more harm than good.

Another very important point in using muscle exercises is to remember that results obtained by their continued use are in direct proportion to the cooperation which the patient gives. It is not enough to advise a patient to do the exercises, but the real task is to get the patient to make a really and truly conscientious effort to follow all instructions carefully.

I have been told repeatedly by various orthodontists that although they themselves believe in muscle exercises as an aid to treatment, in *their* locality the necessary cooperation cannot be secured, with the idea that the responsibility for everything pertaining to the treatment of the case rests entirely on the orthodontist.

I am inclined to doubt this, since human nature runs true to form regardless of locality. The fault lies with the orthodontist in not properly explaining the reasons for the exercises. It is just as important for him to sell the idea that a case cannot be completed without the patient's assistance as it is for the music teacher to enlist the aid of the parent in seeing that the child practices its lesson.

The same principle applies to our work in the treatment of cases. Parents must be educated to their responsibility if orthodontia is to progress along with the other branches of the healing art. Is it not significant that most of the other branches depend upon the patient's cooperation? What powers have we that we should be expected to carry a case through alone? Far better have half a given number of cases with all of them cooperating, than have the worry of trying to complete a large group that just will not respond to treatment because the patient fails to do his or her share.

Most men taking up the muscle training work seem to want a standardized set of exercises for definite cases, that is, one series for neutroclusion cases, another for posterior occlusion cases, and another for anterior occlusion cases. They desire all this without going into the underlying factors concerning muscular exercises. This would certainly be an unscientific method of advising a patient. It would be similar to a physician prescribing a certain combination of drugs, about which he knew nothing, but simply advised because the label on the bottle said it was a cure for the condition he was treating. A physical culturist might advise a number of exercises to accom-

plish one lone purpose. As an example, it does not make much difference in the result if one lies prone on the floor and rises to a sitting position, or if one stands erect and stoops over to touch the floor. In both instances the effect is the same.

Advising a correct series of exercises becomes a simple matter when the operator is certain of the change he wants to bring about. The one big effect we want to accomplish is to bring a poorly functioning muscle under the control of the will, so that it can act in normal function as nature intended it should.

Fig. 1. Fig. 2.

Fig. 3. Fig. 4.

The simpler the exercise advised by the operator the better the younger patients will be able to follow instructions. Any complicated system is liable to prove so irksome that we will defeat our own purpose by advising it. A knowledge of psychology is most necessary in this connection, as the practical application of it proves invaluable in enlisting the aid of both patient and parent.

There is little difficulty experienced in having the patient learn his exercises. The real task is in having him persist in their daily application, but as the importance of consistent application and adherence to the exercises

are explained the patients are usually eager and willing to persist so that they secure all benefit from their use.

It has been stated by some orthodontists that the inability to get the patient's cooperation is a reflection on the operator's ability to handle his patient correctly. This may or may not be true, but one thing is certain that it is very difficult at times to get the necessary cooperation of the patient. For this type of patient I have devised a type of report blank which is filled out and mailed to the parents or guardian of all patients at stated intervals. The progress of the case, the cooperation received and the home care given the mouth by the patient are all reported.

Fig. 5. Fig. 6.

Fig. 7. Fig. 8.

These reports have the effect of placing more responsibility upon the parents. Carbon copies of every report sent out are kept on file with the other records of the case. The effect of this system is twofold: the aid of the parent is enlisted, and the operator is relieved of much blame, which is often a possibility in cases offering no cooperation. The parents are told the facts concerning the case as the treatment progresses, and they react accordingly. This report system relieves us of the embarrassment of trying to explain a failure which in itself is self-evident. Very often the operator's explanation of a failure, as his patient sees it, acts as a boomerang and reflects on him so that he is accused of making excuses to cover his own mistakes. This report system protects the operator from such an occurrence.

In conclusion I wish to state that not with appliances alone will malocclusions be successfully corrected. Nor will malocclusions be successfully corrected with muscular exercises alone. It is the joining of these two methods, the one complementing the other, which will achieve the best results.

We must remember again that there are six forces of occlusion, and also that the six forces of occlusion are the forces of retention.

Fig. 9. Fig. 10.

Fig. 11.

Cause and effect are ofttimes associated so closely in our cases of malocclusion that it is very difficult to determine which is cause and which is effect. In other words, as an example, do patients have thick lower lips because their maxillary teeth protrude, or do their maxillary teeth protrude because they have thick lower lips? The cause and effect are so interrelated that both must be treated simultaneously.

Motion pictures were used to demonstrate the inability of some patients to perform the muscle exercises. The blowing exercises were used for this purpose in the pictures. However, we would find that regardless of the type of exercise given for the muscles of facial expression, the patient, in most instances, would be unable to perform them at first. Appended herewith are a few photographs taken from the original reel of movies, which probably show, to a degree, at least, what can be done in the development of the muscles.

Figs. 1 and 2 show the patient at rest. The case was a mutilated posterior occlusion. Figs. 3 and 4 show the patient attempting to blow out the lower lip. It will be noticed that she cannot do this without blowing out the entire musculature. Figs. 5, 6, and 7 show the patient one year later performing a series of exercises with a greater degree of coordination. Fig. 8 shows the amount of development which has taken place in one year.

Date_____

Case report of_____

Progress of case to date_____

Appointments are being kept_____

Instructions are being followed_____

Patient's home care of the mouth has been_____

Remarks: _____

_____

_____

Fig. 12.

Another very interesting case calling for the use of muscle exercises, is shown in Figs. 9, 10 and 11. The case, as presented, was a neutroclusion case, complicated by a wryneck. The maxilla was contracted on the left side; the entire denture of the maxillary arch was lingual to the mandibular on that side. Fig. 9 shows the facial abnormality. Fig. 10 shows the case after a wryneck operation was performed and muscle exercises instituted on the left side only. Fig. 11 shows the case one year later.

Fig. 12 is a copy of the report blank used in the writer's practice to stimulate better home cooperation on the part of the parents.

Mention might be made here of the fact that in making still pictures from the original movie reel considerable detail has been lost.

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BONE CHANGES DURING TOOTH MOVEMENT

By Albin Oppenheim, Vienna
Translated by Egon Neustadt, New York

SEVERAL American orthodontists have expressed their regret that the reproductions in my first paper on this subject* were only drawings and not photomicrographs. I was subjected to the same criticism by Dr. Walkhoff of Germany, the main exponent of the elasticity theory, who asserts that elasticity, pliability, and compressibility of the bone trabeculae are mainly responsible for tooth movement. In tooth movement, according to his assertion, a dislocation of the trabeculae takes place beyond their elastic limit, and later on they become firm in their dislocated position. The statement is made that the pressure applied during movement will not permit of absorption or apposition by the tissue elements.

In order to disprove the elasticity theory which is not based on experimentation of any kind, I shall prove conclusively that histologic changes are already apparent after a pressure for five days. From my old experiments, I shall show these changes around the teeth of monkeys, publishing the photomicrographs along with the drawings. I shall also show them around the teeth of dogs taken from a series of new experiments which were made to verify earlier findings. The slides from which the drawings of the original experiments were made have since been lost, but slides of the same serial sections will be used. The correlated illustrations differ only in small details, which is an excellent proof of the correctness of the original drawings. The explanations have been taken from the original publication and refer to both illustrations.

I have stated in my earlier deductions that under the influence of long-continued pressure apposition of bone overweighs absorption; on the lingual side of the tooth I have found during lingual movement that the bone trabeculae on the side of pressure show wide unossified areas as a sign of intensive new bone formation. On the strength of my latest investigations which shall be dealt with in this article, I can further explain: that bone under the influence of the pressure at first is absorbed, later on if the pressure is physiologic and the intervals between the application of the force are sufficiently long, the signs of absorption disappear from the histologic picture, and the signs of repair and new apposition are seen.

In Fig. 1 the original drawing (*A*) and the microphotograph (*B*) are shown together representing the labial movement after application of force for forty days. Fig. 2 is a larger magnification of *a* in Fig. 1 (*B*). It hardly leaves any doubt that while osteoclasts (*ok*) are absorbing bone on the inner wall, simultaneous formation of new bone is under way on the opposite side of the process. The new bone formation is demonstrated through growing buds

*Josef Grunberg and Albin Oppenheim: *Orthodontishe Therapie,* Fortschr. d. Zahnheilk. 4: 1928.

of bone trabeculae (k_1) arranged in a direction perpendicular to the tooth and consisting of osteoid tissue (k_2). They are lined closely with osteoblasts. (Also compare k_1 of Fig. 6 after a five-day application of force.) In Fig. 3 the drawing and photomicrograph of the side of pressure in lingual movement is presented. Osteoclasts have almost entirely disappeared; everywhere extensive new bone formation may be seen. The lingual side of the tooth during elongation

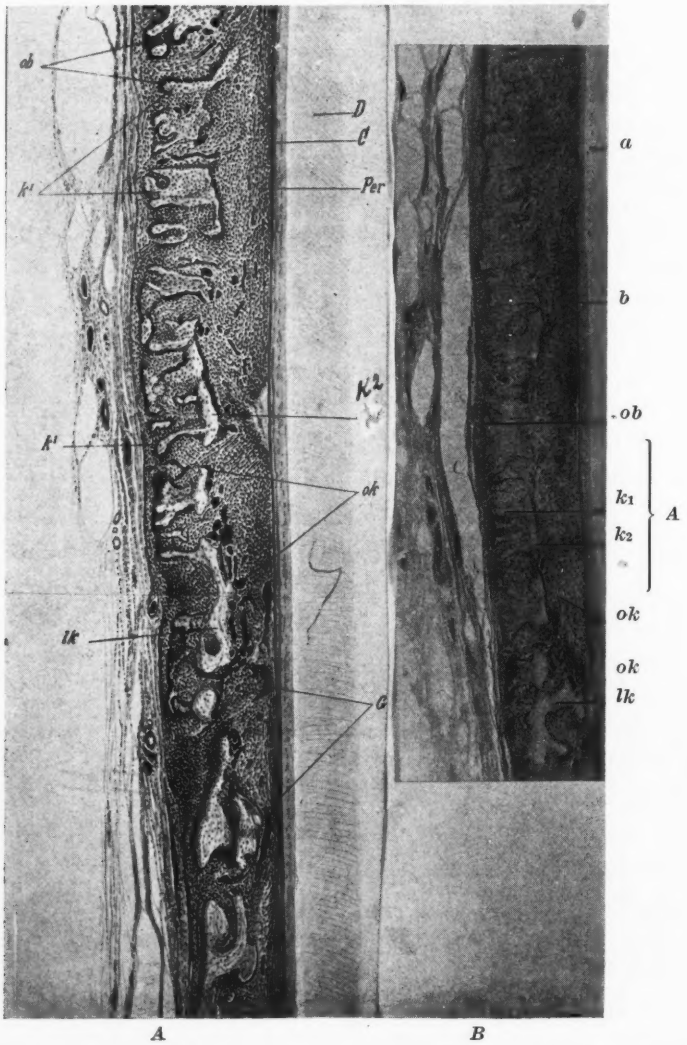


Fig. 1.—Bone changes in labial movement; labial side. *A*, drawing; *B*, photomicrograph. At *ob*, near the crest of the alveolus, compact bone has disappeared and has been substituted by cancellous bone; the trabeculae of the latter are arranged in a direction perpendicular to the long axis of the tooth; the bone between *G* and *ok* is in a state of transition. *a*, dentin; *b*, cementum; *g*, peridental membrane; *G*, blood vessels; *lk*, compact bone with lamellous structure; *ok*, osteoclasts; k_1, new bone trabeculae, lined with osteoblasts (*ob*); k_2, rest of compact bone that has lost its lamellous structure. Magnification 40.*

*All the illustrations in this article have been reduced one-fifth.

is shown in Fig. 4 and illustrates the fact that the bone reacts to the stimulation of tension with a deposition of bone. Fig. 5 shows the labial side under the application of extreme pressure. There is no reaction in the bone, and the blood vessels are thrombosed. In Fig. 6 the deciduous incisor with an unabsorbed root of a pavian monkey can be seen after an application of force for

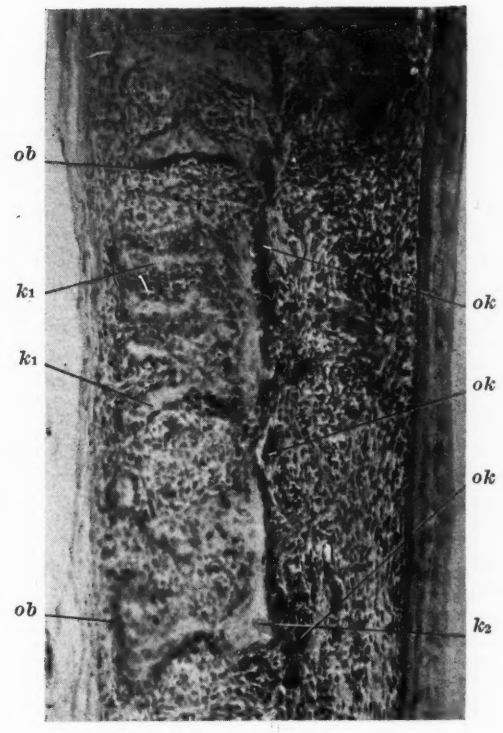


Fig. 2.—Bone changes in labial movement. Area *a* from Fig. 1. *ob*, osteoblasts; *ok*, osteoclasts; k_1, newly formed trabecula; k_2, rest of compact bone. Magnification 120.

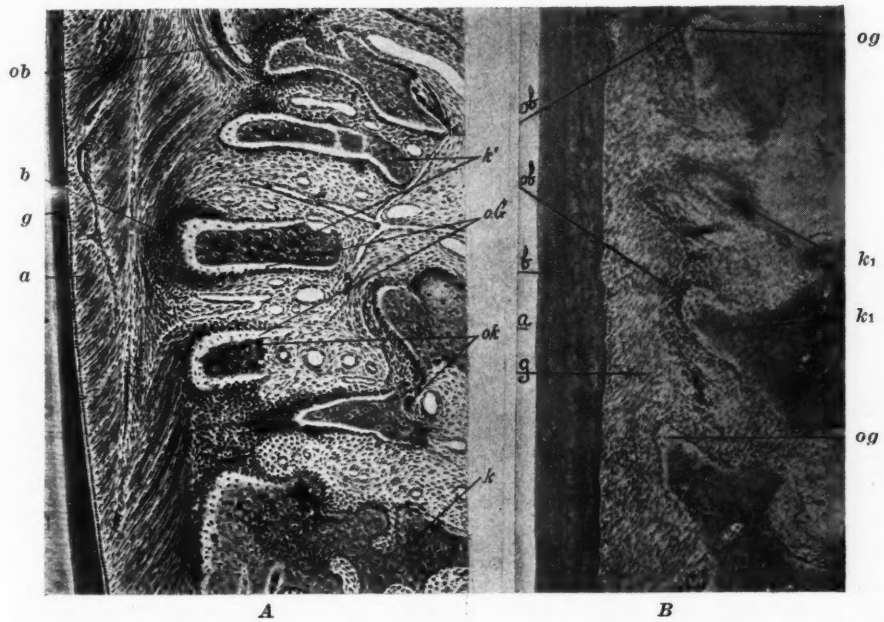
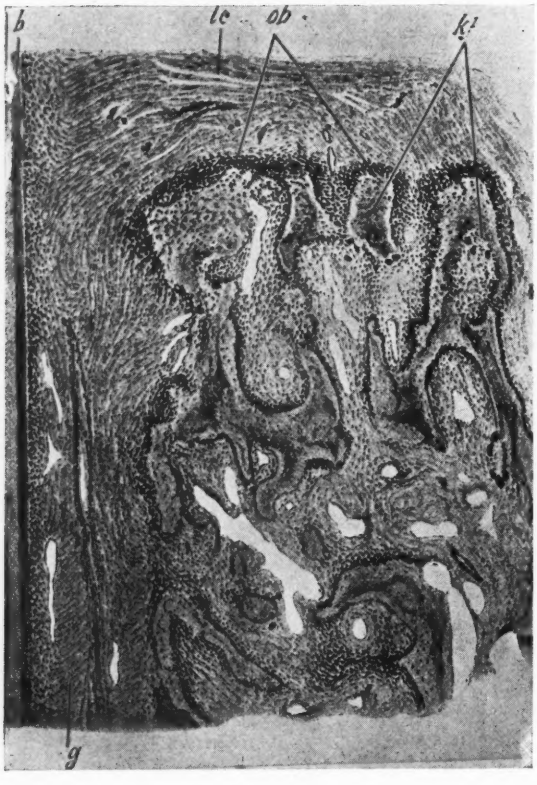
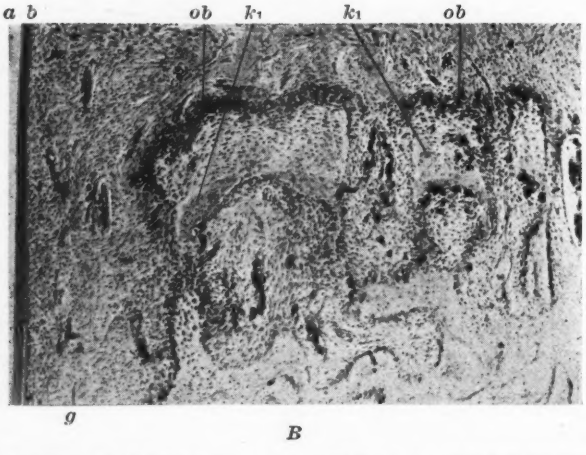


Fig. 3.—Bone changes in lingual movement. *A*, drawing; *B*, photomicrograph. Lingual side. Near the alveolar crest are bone trabeculae (k_1) arranged in the direction of the pressure; they are lined by osteoid tissue (*og*) and covered by a layer of osteoblasts (*ob*); *a*, dentin; *b*, cementum; *g*, peridental membrane; *ok*, osteoclasts; *k*, old unchanged bone near apex. Magnification 40.



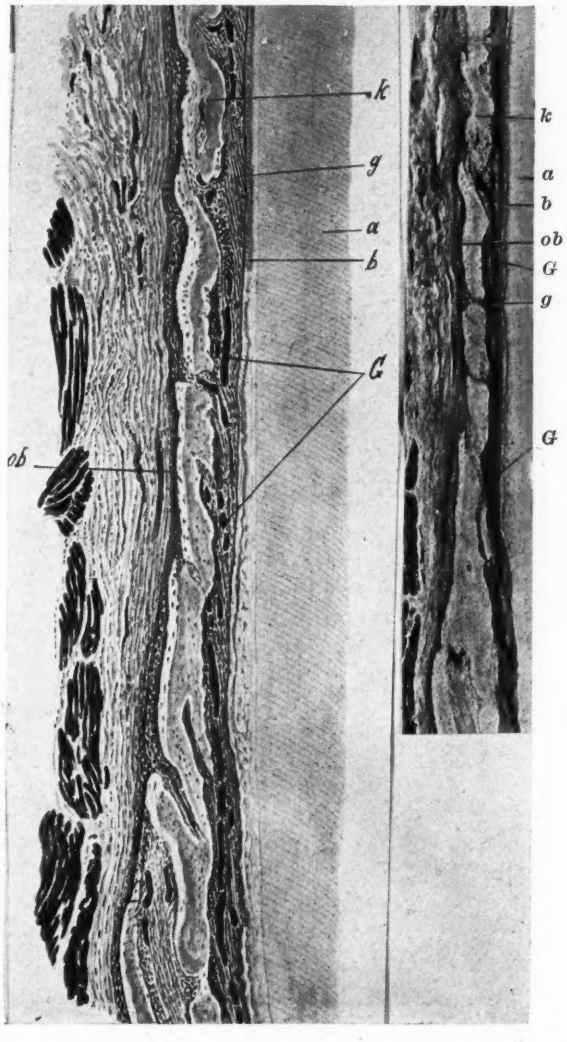
A



B

Fig. 4.—Bone changes in elongation. *A*, drawing; *B*, photomicrograph; lingual side of alveolus. k_1, new trabeculae, arranged in the direction of the tension; *a*, dentin; *b*, cementum; *g*, peridental membrane; *lc*, circular ligament; *ob*, osteoblasts. Magnification 40.

five days. The pressure was exerted on the first day and not repeated. It must be pointed out again, as in my first publication, that very few and sometimes no teeth which were under observation showed signs of root absorption by the action of their permanent successors; the roots of the moved teeth were entirely normal and fully developed and presented the same conditions as fully developed permanent teeth. On the right side of the picture, the side of the pressure, we



A B

Fig. 5.—Bone changes under the influence of strong forces. *A*, drawing; *B*, photomicrograph. Labial movement; the compact layer of bone (*k*) somewhat thinned out, but no histologic changes of absorption and apposition present; all blood vessels (*G*) filled with a homogeneous mass (thrombosed?); *a*, dentin; *b*, cementum; *g*, membrane; *ob*, a few osteoblasts. Magnification 40.

see the compression of the peridental membrane as compared to the left side. On the surface facing the tooth, old bone can be recognized by its dark color (*lk*) with only a few osteoclasts (*ok*). On the surface away from the tooth new trabeculae are being formed, arranged perpendicular to the long axis of the tooth (k_1). This osteoid tissue is characterized by its lighter color and its lining of osteoblasts.

Fig. 7 presents a larger magnification of the area *A* from Fig. 6. Fig. 8 is still a larger magnification of a single trabecula (*c*) from Fig. 7 in which is clearly indicated the presence of absorption and deposition of bone with predominance of the latter. After applying tension on the tooth for five days, we can notice on the left side of Fig. 6 the reaction of the bone. Several new trabeculae (k_1) have been formed, arranged in the direction of the tension. They are shown in larger magnification in Fig. 9. (Area *B* of Fig. 6.) This picture also convinces us of the fact that under the stimulation of external force a process of

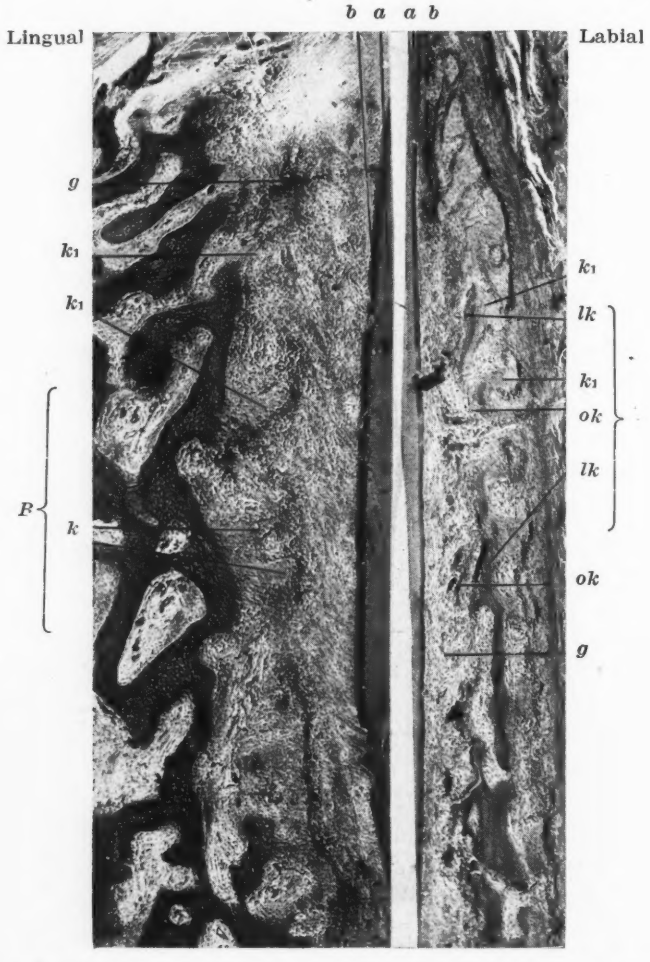


Fig. 6.—Bone changes after a five-day application of force. *lk*, compact lamellous bone; k_1, newly formed trabeculae; *ok*, osteoclasts; *a*, dentin; *b*, cementum; *g*, peridental membrane. Magnification 40.

rebuilding takes place and that the bone reacts in a similar physio-biologic way to pressure as well as to tension when mild forces are used.

We shall now consider the findings of a series of experiments made on the permanent teeth of dogs. Labial movement was produced, and the application of force was renewed each week. For the sake of comparison, we show first one of the control teeth (Fig. 10). We see on the lingual side (left) much resorption going on with many osteoclasts (*ok*) in the field, while on the labial side (right) we see deposition of bone and lines of osteoblasts (*ob*)

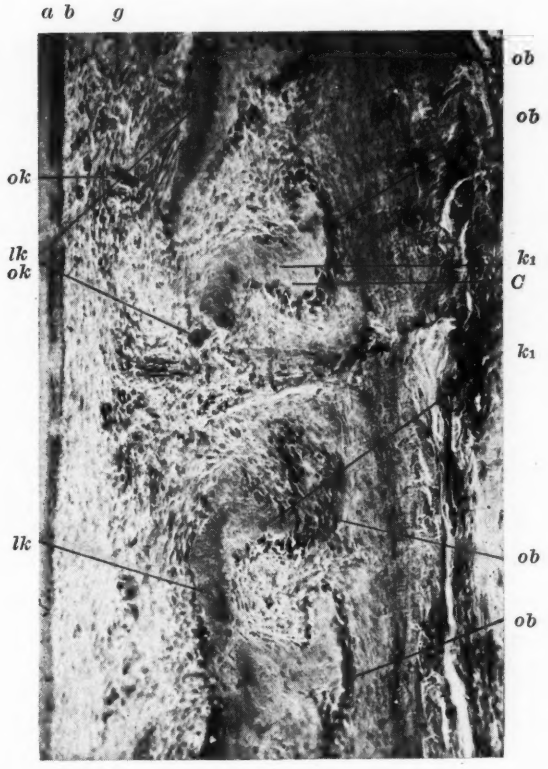


Fig. 7.—Bone changes after a five-day application of force. Labial side; area *A* from Fig. 6; *lk*, old lamellous bone; k_1, newly formed bone trabeculae, arranged in the direction of the pressure, lined with a layer of obsteoblasts (*ob*); *a*, dentin; *b*, cementum; *g*, peridental membrane. Magnification 120.

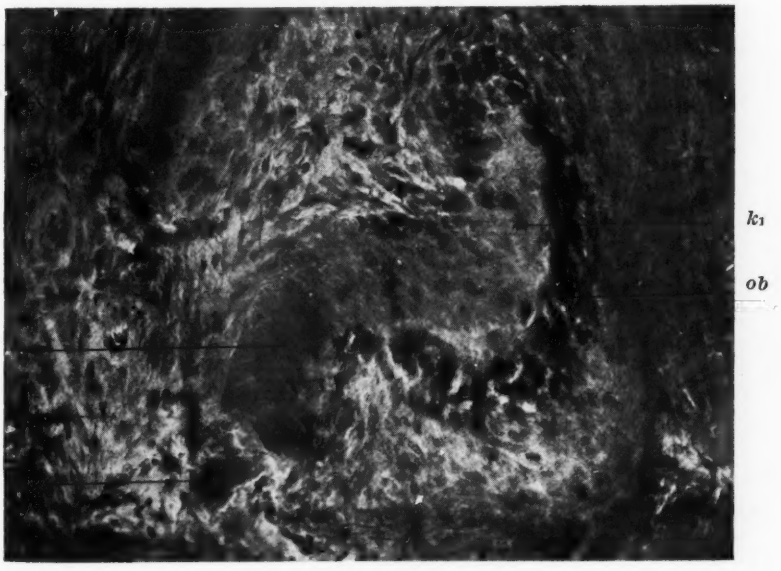


Fig 8.—Bone changes after a five-day application of force. Labial side Bone trabecula *c* from Fig. 7; *lk*, lamellous bone; k_1, newly formed trabecula densely covered with osteoblasts (*ob*); *ok*, isolated osteoclast; *g*, peridental membrane. Magnification 350.

Fig 9.—Bone changes after a five-day application of force; lingual side. Area *B* from Fig. 6. k_1, newly formed bone trabeculae; *ob*, osteoblasts; *a*, dentin; *b*, cementum; *g*, peridental membrane. Magnification 80.

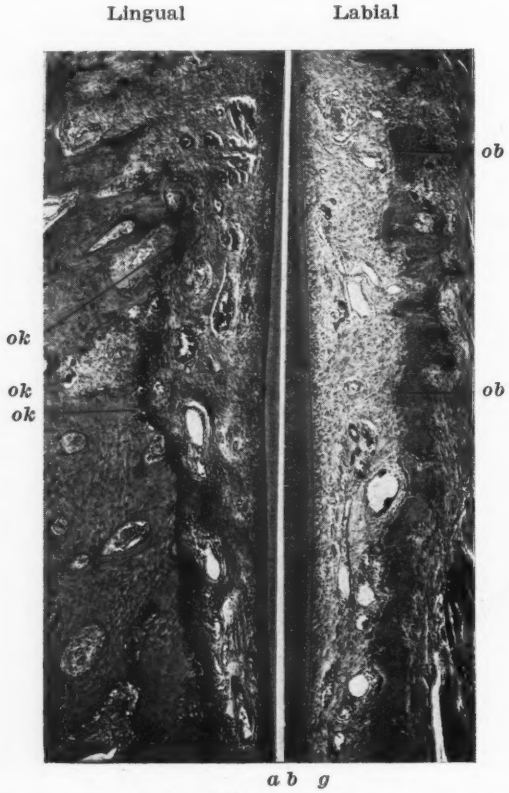


Fig. 10.—Control picture of a normal permanent tooth of a dog. *ok*, osteoclasts; *ob*, osteoblasts; *a*, dentin; *b*, cementum; *g*, peridental membrane. Magnification 40.

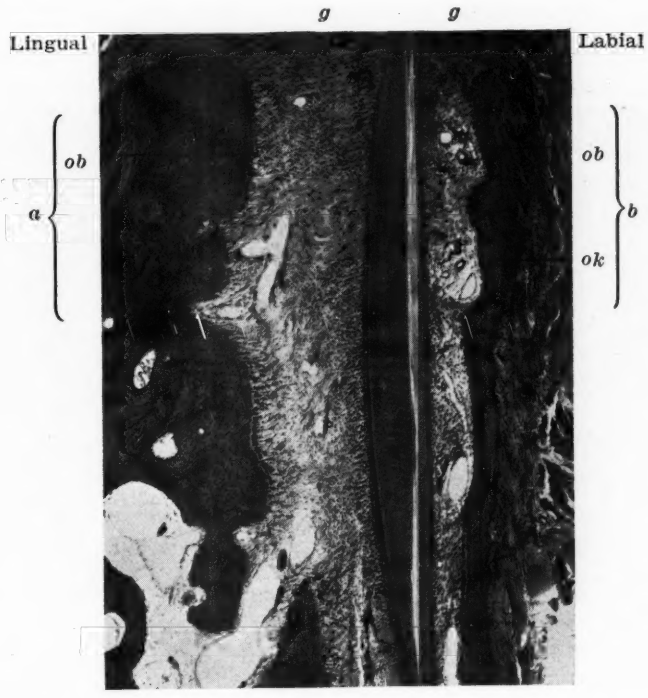


Fig. 11.—Tooth of dog. Labial movement; one week; right, labial side; left, lingual side; *ob*, osteoblasts; *ok*, osteoclasts; *g*, peridental membrane. Magnification 40.

Fig. 12.—Tooth of dog. Labial movement; one week; labial side; area *b* from Fig. 11; *ob*, osteoblasts; *ok*, osteoclasts. Magnification 120.

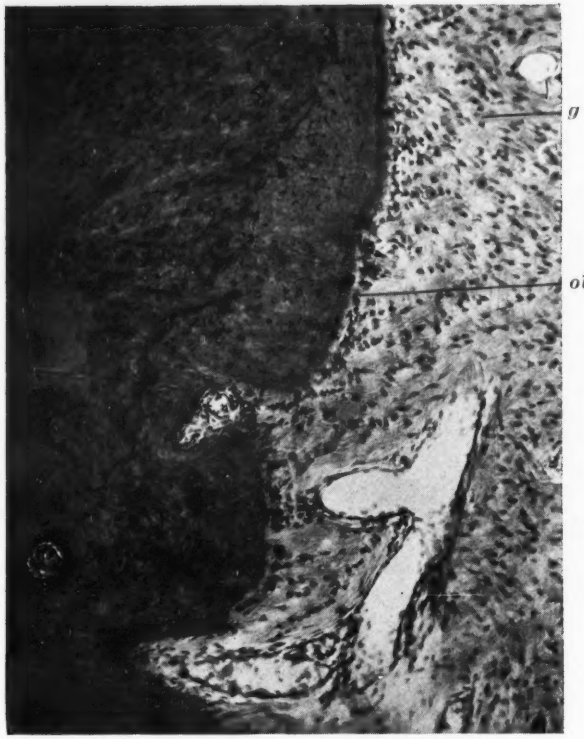


Fig. 13.—Tooth of dog. Labial movement; one week; lingual side; area *a* from Fig. 11; *g*, peridental membrane; *ob*, osteoblasts. Magnification 120.

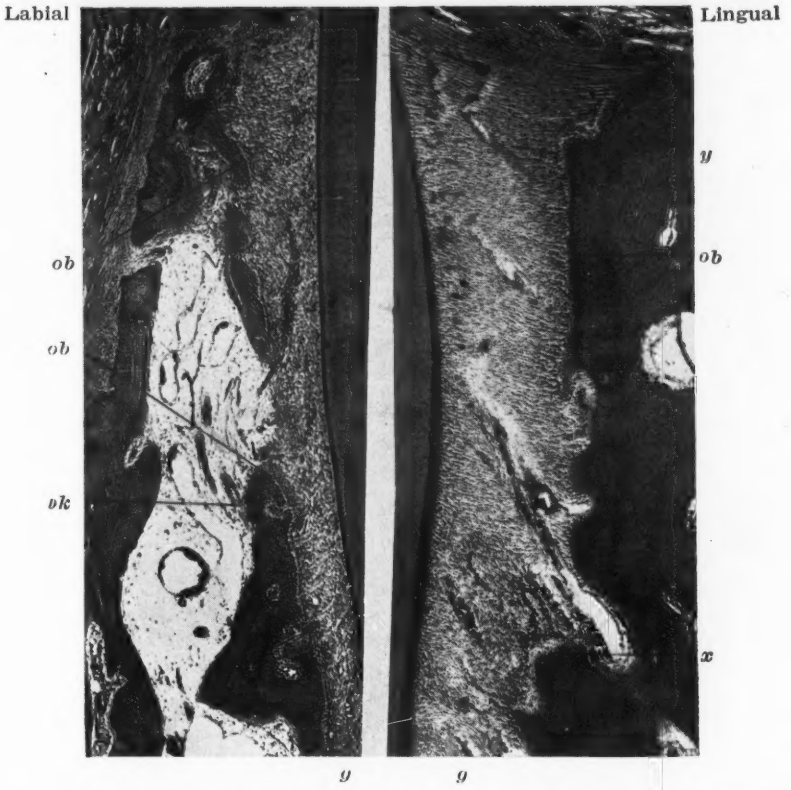


Fig. 14.—Tooth of dog. Labial movement; two weeks; *g*, peridental membrane; *ob*, osteoblasts; *ok*, osteoclasts; *x* and *y*, newly formed trabeculae. Magnification 40.

with osteoid tissue. In Fig. 11 we notice the results of the labial movement after an application of force for one week. The appliance was adjusted October 1; the animal was killed October 8. On the labial side (right) the process of bone deposition seems somewhat slackened, as compared with the control tooth, and one osteoclast can be found (*ok*). The osteoid linings are slightly narrower, the osteoblasts (*ob*) less frequent. This may be due to the fact that the pressure of the regulating appliance had not entirely subsided. In Fig. 12 the area *b* of Fig. 11 is shown in a high magnification. The difference in the width of the peridental membrane between labial and lingual is striking. In Fig. 13 the area *a* of Fig. 11 is shown in a high magnification. Here the reaction to the stimulation of tension is already clearly demonstrated in the formation of osteoid linings and a dense layer of osteoblasts (*ob*).

The condition of the alveolar process after the application of force for two weeks is given in Fig. 14. The appliance was adjusted September 24, and the animal was killed October 8. The formation of new trabeculae took place on two places of the lingual side (*x* and *y*), while in the other parts the usual signs of apposition are prevalent (*ob*). The width of the peridental membrane, smaller on the labial side (left) than on the lingual side (right), has not yet returned to normal. There is not a single osteoclast on the labial side (pressure), but symptoms of apposition, osteoid lining with layers of osteoblasts (*ob*), reach from the crest of the alveolus to the middle part of the root. On that side of the bone trabeculae which is farther away from the tooth osteoclasts (*ok*) appear.

The next experiment was extended over a period of three weeks with one adjustment of the appliance each week. The appliance was adjusted and force renewed on September 17, September 24, and October 1. The animal was killed on October 8. The findings are recorded in Fig. 15. The width of the periodontium on the side of pressure (right) and the side of tension (left) is nearly equalized. On the labial side the bone has a wavy outline as a result of former osteoclastic activity, but the wide osteoid linings and layers of osteoblasts indicate that this side is now in an active state of new bone formation. In Fig. 16 is shown a larger magnification of area *a* from Fig. 15. Also on the lingual side are found signs of bone formation. Fig. 17 demonstrates the results of four weeks of movement with the appliance adjusted once every week. The adjustments were made September 9, 17, and 24, and October 1. The animal was killed on October 8. Signs of bone resorption cannot be found on the labial (left) nor on the lingual side (right). There is new bone formation under way; the peridental membrane is of equal width on both sides.

The next experiment extended over five weeks, with the appliance adjusted once a week during the first three weeks. Adjustments were made September 1, 9, and 17. The tooth then touched the labial alignment wire, and ligature was used for retention. The animal was killed on October 8. On the labial and on the lingual sides (Fig. 18) are discernible only signs of bone deposition, extending from the crest of the alveolus into the middle of the root. Approximately one-half of the thickness of the alveolar bone on the labial side (right) facing the tooth has been replaced by newly formed bone. The new bone can be traced in its outline in the continuation of the lines *A* and

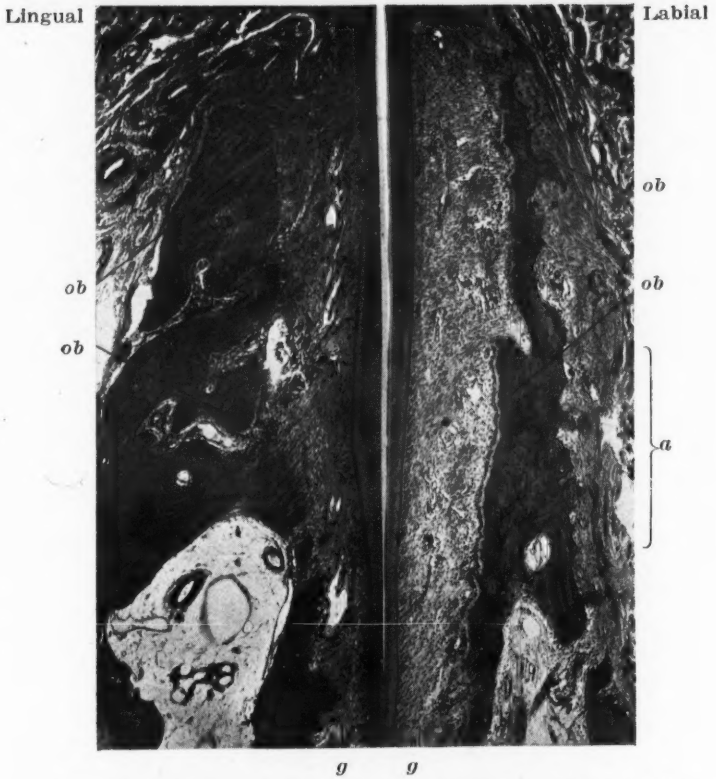


Fig. 15.—Tooth of dog. Labial movement; three weeks; *ob*, osteoblasts. Magnification 40.

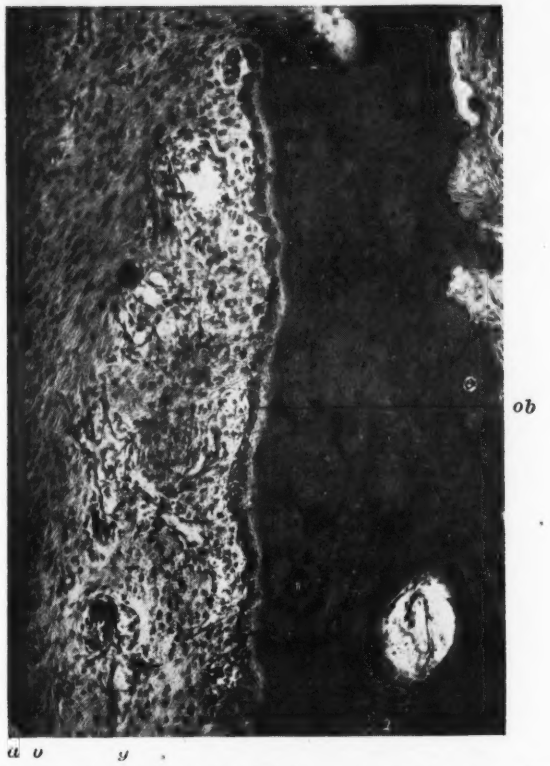


Fig. 16.—Tooth of dog. Labial movement; three weeks; labial side, area *a* from Fig. 15; *ob*, osteoblasts; *a*, dentin; *b*, cementum; *g*, peridental membrane. Magnification 120.

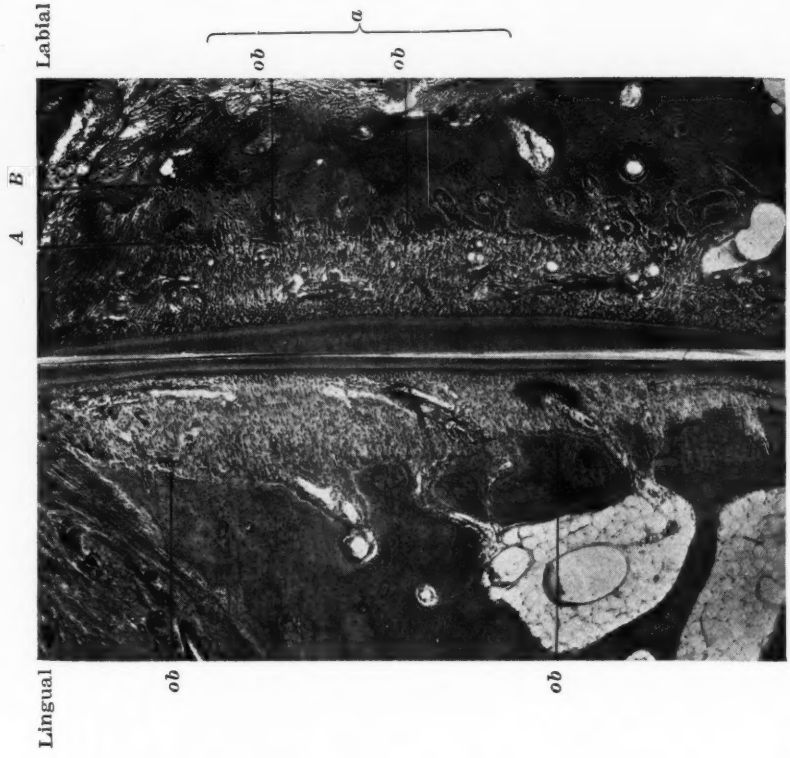


Fig. 18.—Tooth of dog. Labial movement; five weeks; *ob*, osteoblasts. Magnification 40.

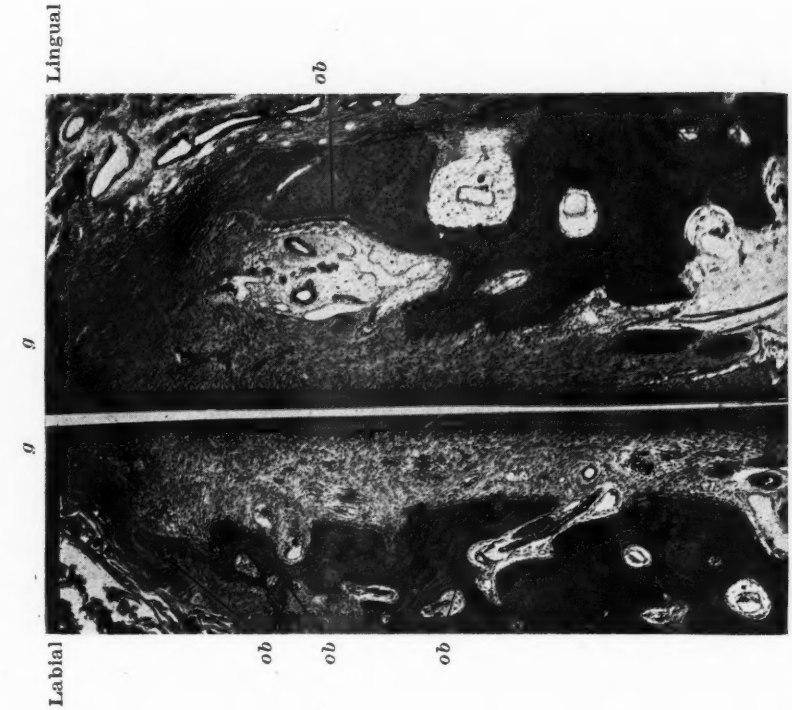


Fig. 17.—Tooth of dog. Labial movement; four weeks; *ob*, osteoblasts; *g*, membrane. Magnification 40.

B. It is characterized as new bone through its lighter color and the absence of Haversian canals. The line of demarcation between old and new bone is a wavy line, indicating clearly the former activity of osteoclasts. The surface of the bone facing the tooth shows the same outline, but the lacunae are now filled with osteoblasts (*ob*). The bone is in a state of most active reproduction.

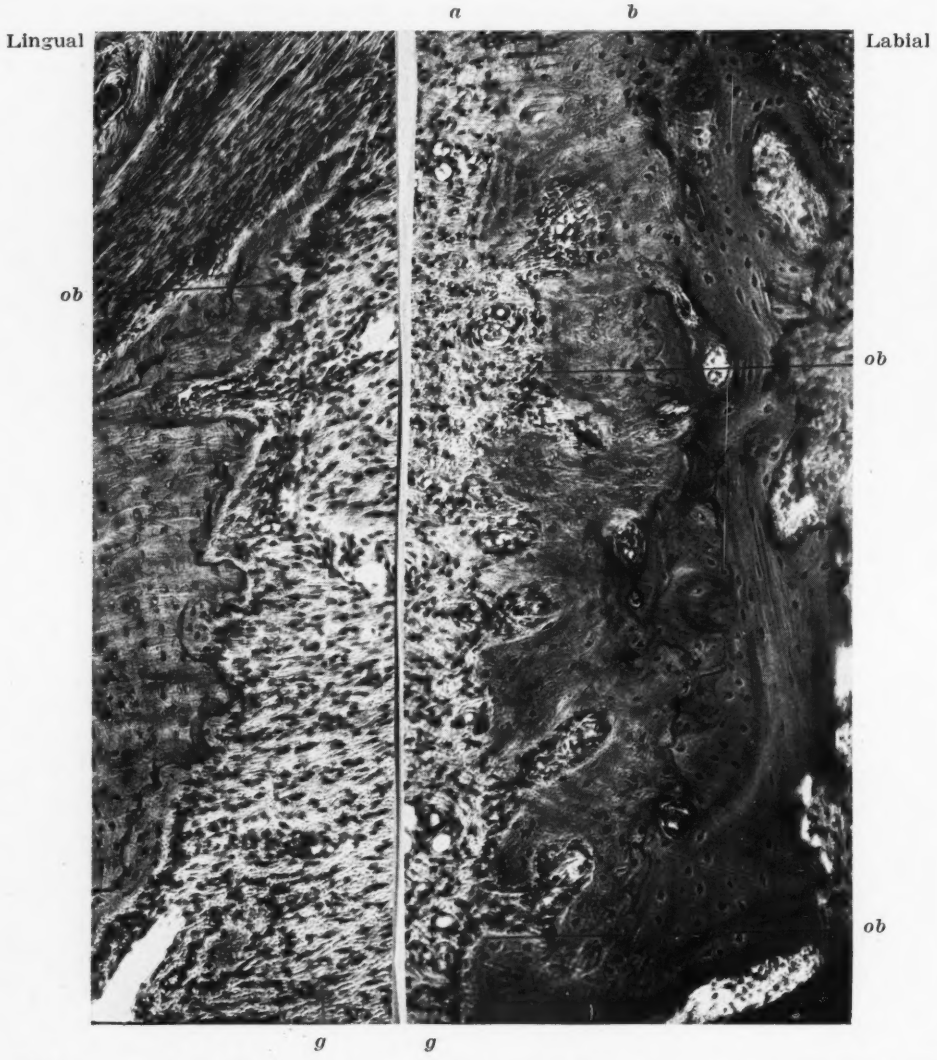


Fig. 19.—Tooth of dog. Labial movement; five weeks; on right of picture labial side of area *a* from Fig. 18; on left, lingual side from Fig. 18; *ob*, osteoblasts; *g*, peridental membrane. Magnification 120.

Fig. 19 is high magnification of the area *a* from Fig. 18. The lingual side is shown on the left and the labial side on the right. The bone deposition on the side of tension (left) takes place always in a smooth line, as on this side, in a labial movement of the tooth resorption never occurs. The width of the peridental space is the same.

Another experiment was conducted over a period of five weeks, with adjustments made twice at two-week intervals; adjustments made September 3, and

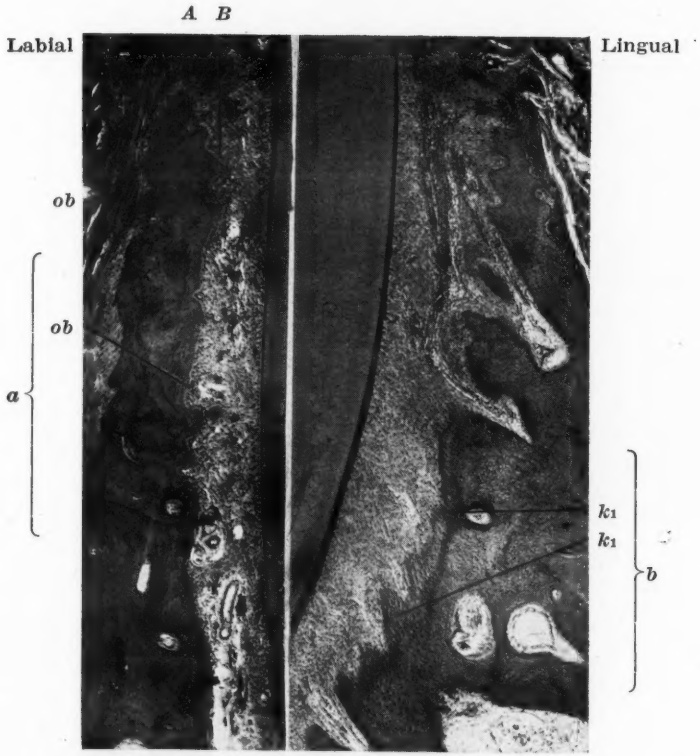


Fig. 20.—Tooth of dog. Labial movement; five weeks; *ob*, osteoid lining and osteoblasts. Magnification 40.

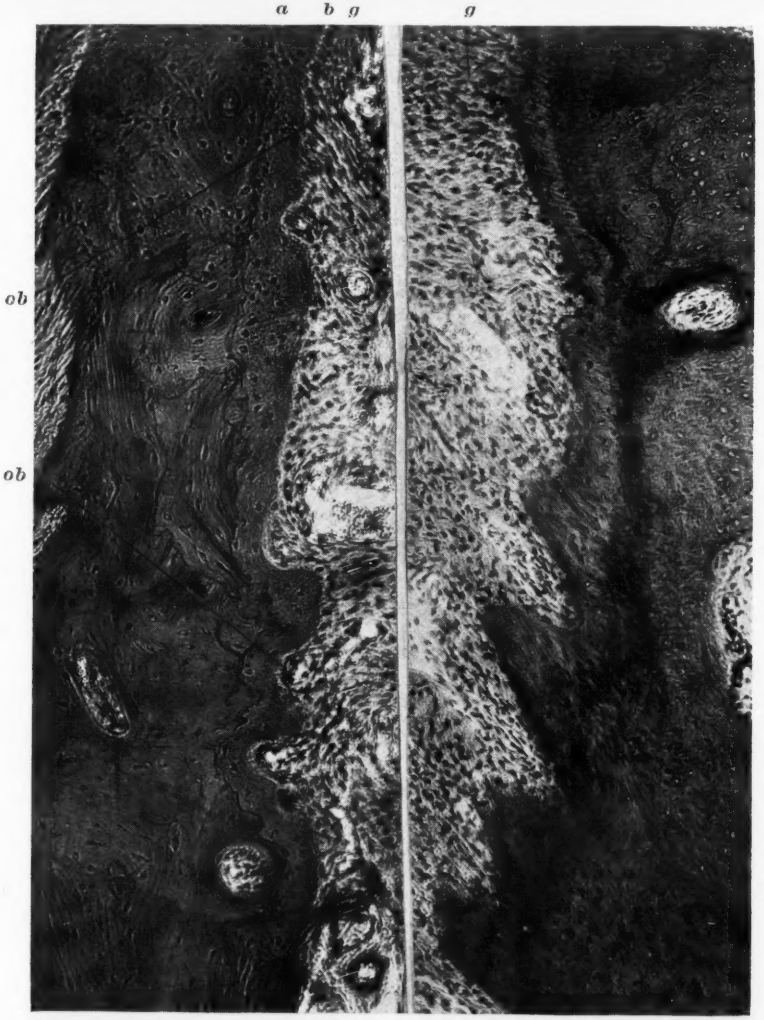


Fig. 21.—Tooth of dog. Labial movement; five weeks; area *a* (left) and *b* (right) from Fig. 20; *g*, peridental membrane; *ob*, osteoblasts. Magnification 120.

17. The animal was killed October 8. The histologic picture (Fig. 20) is very similar to the one described above. The labial (left) and the lingual side show signs only of deposition. A narrow strip of new bone is easily discernible on the inside of the labial wall from the old bone by its light color and the lack of Haversian systems. The new bone can be followed over half of the root between the lines *A* and *B*. The osteoid linings and layers of osteoblasts (*ob*) are signs of bone deposition. A large magnification is reproduced in Fig. 21 (left). (Area *a* from Fig. 20.) Heavy new bone trabeculae appear on the lingual side (k_1 from Fig. 20), which area (*b*) is enlarged in Fig. 21 (right).

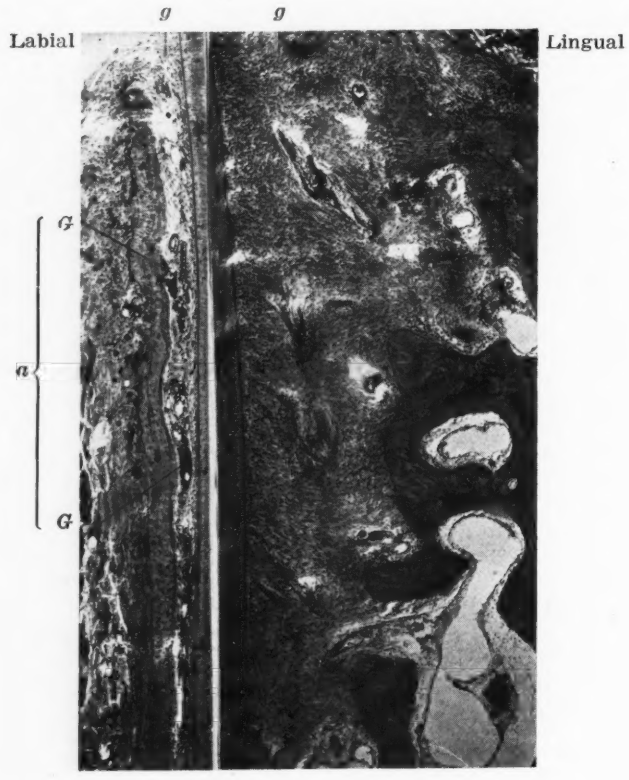


Fig. 22.—Tooth of dog. Labial movement; four days. Strong pressure. Labial side on left, lingual side on right of picture; *g*, peridental membrane; *G*, thrombosed vessels. Magnification 40.

Fig. 22 demonstrated the results of a four-day strong force application. No indications of a bone reaction can be found either of a productive or of a destructive character on the labial (left) as well as on the lingual (right) side. The difference in the width of the peridental membrane between labial and lingual is striking, and also the thrombosed blood vessels on the labial side are similar to Fig. 15. The peridental fibers on the lingual side are stretched and partly torn. Area *a* from Fig. 22 is more highly magnified in Fig. 23.

On the strength of these findings, it can be laid down, as a general rule, that a mild application of force, administered over long periods of time, constitutes the best orthodontic treatment. The intervals should be long enough to permit

the osteoblasts, which appear simultaneously with the osteoclasts, to restore normal conditions after the osteoblastic action has ceased.

In this continuous rebuilding lies the reason for the fact that teeth remain firm during slow tooth movement. With the application of strong forces, the

Fig. 23.—Tooth of dog. Labial movement; four days. Strong pressure. Labial side. Area *a* from Fig. 22; *g*, thrombosed vessels. Magnification 120.

normal reaction of the bone is lacking (through tearing of fibers and thromboses), as can be seen in the experiments on monkeys, Fig. 15, and on dogs, Fig. 22. If deductions are made from these experiments to human beings, the interval between the adjustment should be made even longer, for the span of life of the dogs and their biologic reactions are shorter than those of men.

DEPARTMENT OF
ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of
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THE STATUS OF FOCAL INFECTION

By Wallace M. Yater, A.B., M.S., M.D., Washington, D. C.
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IN AUGUST, 1928, Dr. Charles H. Mayo read a paper at the third general meeting of the American Dental Association entitled "The Interdependence of Medicine and Dentistry." Among other things he emphasized the point that dentistry and medicine originated from the same cult and that dentistry is really one of the medical sciences. That being the case, it is just as necessary for a dentist to know considerable about general medicine as it is for any medical specialist. We say that a good medical specialist is one who not only knows his special branch but has a broad knowledge of all phases of medicine.

For many years, however, dentistry and medicine had been growing more and more independent, until the fact became established that the teeth often have a great deal to do with disease of the organism as a whole. In the last few years, therefore, dentistry and medicine have been approaching each other more and more intimately in the matter of preventing and curing disease. The day has passed when men believed that all a dentist had to do was to preserve teeth for purposes of mastication and satisfying personal vanity.

Nothing has been more conducive to uniting the dental and medical professions than the increase of our knowledge regarding focal infection. The great Hippocrates appreciated in a way the effect of diseased teeth upon the organism, but it has only been in recent years that the matter has really been studied in a scientific way. Even now there is much more to be learned about the subject. It is surprising, too, that many men still do not accept the theory of focal infection. Practically all that is known regarding focal infection has been developed by American investigators. We Americans may have gone crazy on the subject, but our brothers abroad have certainly been too cautious

to preserve their sanity. Who can say but what the insane are really in a happier state than the sane?

To concentrate now for a few moments on this subject it is important to establish certain fundamentals. A focus of infection may be any part of the body which is infected and from which pathogenic organisms may be distributed to other parts of the body. From the standpoint of function this focus may not be, and often is not, an indispensable part of the body, so that removal has little effect on the functioning of the organism as a whole. The teeth, while often foci of infection, are by no means the only parts of the body which commonly act as foci. The organs of the body which are most prone to become such foci are the tonsils, the teeth, the paranasal sinuses, the prostate, the cervix uteri, the gall bladder, the appendix and the intestines. I consider the last three as unimportant compared to the first five. While most acute infections are really focal in origin, since the invading organisms gain entry through some part of the body which itself first becomes acutely infected, we usually refer to chronically infected organs as foci of infection. It is from these slumbering volcanoes that many of our chronic disease processes originate. Exactly when and how these foci become established can usually not be determined in the individual case. Very often foci produce no subjective symptoms, and their presence is determined only by painstaking examinations.

Foci of infection are removed for one of two purposes: (1) to prevent secondary infection of other parts of the body, and (2) to prevent their continuance as feeders of bacteria to already secondarily infected parts of the body. Naturally, when an organ is removed, it can no longer act as a focus of infection; but if some other organ has already become diseased from this focus, one cannot expect the simple removal of the focus to cure the disease already established in another organ. All he can reasonably hope is that, the focus being eliminated, the diseased organ may be able to cope with the infection already present and not be reinfected from time to time by the original focus. From a practical standpoint, therefore, it is more important to remove infected parts which are commonly looked upon as foci before secondary infection has occurred than afterward. The secondarily infected organ may be permanently damaged and permanently infected. This explains the failure of results in many cases following removal of foci. Nevertheless, even in such cases removal is advisable to prevent reinfection from the focus.

In the individual case the physician is unable to determine which of several possible foci may be responsible for a given condition, except perhaps by lengthy investigations with cultures and animal inoculation, a procedure which is not possible in ordinary practice. The rational plan, therefore, is to remove or treat all infected organs which may be foci. To remove infected teeth and to leave infected tonsils would be a foolish policy. Not all foci are as easy to eliminate as the teeth and tonsils. Eradication of infection in chronically diseased sinuses is difficult, and one is not justified in removing an infected prostate. The cervix uteri may be fairly readily disinfected by cauterization or surgical removal. Convicting the gall bladder is hazardous unless there

is outspoken evidence of infection. The same applies to the appendix. Most difficult of all is the establishment of the intestines as a focus of infection, and treatment is unsatisfactory.

Regarding the teeth in particular, one is justified in recommending extraction of all teeth associated with fistulas, all teeth which roentgenologically show evidence of periapical bone absorption and all nonvital or pulpless teeth. The latter are found often to be periapically infected even when roentgenologically negative. These very teeth have been shown to be most important as foci of infection. The value of transillumination in the diagnosis of periodontal infection even when the x-ray picture is negative has probably not been properly appreciated. Dr. Mead and I are now conducting investigations to determine just how valuable transillumination is. Pyorrhea may also be a source of systemic infection. If treatment is insufficient to control pyorrhea, extraction is warranted. To extract periapically infected teeth and leave existing pyorrhea untreated would not be giving the patient the best service. One must not forget either that an edentulous mouth may still harbor buried foci in the form of root residuals, and that in order to eliminate this possibility roentgenograms are indicated as part of a thorough search for foci.

The work of Rosenow has been severely criticized, and yet he deserves perhaps the greatest credit for persistent and painstaking efforts to clarify the subject of focal infection. No doubt he has been overenthusiastic and has taxed the imagination of most of us by applying his theory of specific localization to almost every known disease. One cannot, however, visit Rosenow and see his work at first hand without absorbing some of his enthusiasm. Many of his results have been dramatic. Recently others have been reporting work which strengthens Rosenow's position. If the theory of elective localization is true, it seems very strange that the organism usually isolated, viz., the Streptococcus viridans, should after inoculation into an animal know just how to find the kidneys or the joints or the same organ which he inhabited in a previous host. This is a century, however, when once-strange things are becoming commonplaces, so that eventually we may accept even Rosenow's ideas. While Rosenow's theory of elective localization may not be at present attractive to many, we must admit that he has proved conclusively that bacteria which have gained a permanent foothold in the teeth or tonsils are often responsible for serious disease in other parts of the body.

I shall attempt in a concise way to discuss the part which focal infection plays in diseases of the various systems of the body, stressing the relative importance of dental infection in each. To begin with the cardiovascular system, there is little to be said concerning the rôle of focal infection as a causative element. High blood pressure, and I refer to essential hypertension, which is the most common variety, apparently is not an infectious condition. Removal of foci of infection has no effect upon the course of the disease. Hypotension, on the other hand, whether of the most common or secondary variety or whether essential, seems often to be due to focal infection. And the presence of bona fide hypotension warrants a thorough search for all possible foci. Chronic diseases of the heart are almost never associated etio-

logically with focal infection, except rheumatic endocarditis; in this condition the tonsils are usually considered the source of infection, but once the disease has become well established, removal of all foci does not often seem to have much to do with the patient's condition. Diseases of the peripheral blood vessels, such as thrombo-angiitis obliterans and Raynaud's disease, have not been definitely linked up with focal infection. Nor can we say positively that focal infection has a great deal to do with the early appearance or the severity of arteriosclerosis.

While focal infection has, therefore, apparently not so much to do with the diseases of the heart and arteries, it comes into some prominence when we turn our attention to the genitourinary system. There is a form of nephritis, the only symptom of which often is a little blood in the urine, which is positively due to infection coming usually from the teeth or tonsils. Removal of the focus may save the kidneys, and leaving it in allows reinfection to occur repeatedly, so that eventually much of the kidneys may be destroyed. Probably also many cases of acute and chronic glomerulonephritis are due to organisms gaining entrance through a focus, and great care should be taken in such cases to remove all possible foci. Renal calculi are probably usually of focal origin, as Rosenow and Meisser have so well shown. Pyelitis and pyelonephritis are common diseases of the kidneys which call for elimination of all foci. Diseases of the reproductive organs are not often directly attributable to focal infection.

Most diseases of the lungs are not due to focal infection, but the presence of chronic bronchitis, bronchiectasis, or chronic parenchymatous disease of the lower half of the lung calls for a careful search for foci. The paranasal sinuses are more often responsible in these conditions than are other foci.

I do not believe that we are yet in a position to say exactly what part focal infection plays in diseases of the gastrointestinal tract. I make a practice, however, of removing all foci in patients with ulcer of the duodenum or stomach and in those who suffer from what is termed irritable bowel and spastic colon. Infection of the gall bladder can rarely be directly linked with distant foci of infection.

The rôle of focal infection in diseases of the nervous system has not been established, but evidence is accumulating to show that such infection may be a factor in some diseases, such as encephalitis, chronic myelitis and multiple sclerosis. Neuritis is sometimes of focal origin.

Diseases of the blood, except symptomatic purpura hemorrhagica, are probably not due to focal infection. Inflammatory diseases of the eye and neuroretinitis have been shown to be due often to foci, in women many times an infection of the cervix of the uterus.

When we come to the muscles and joints, we tread upon well-worn paths in our discussion of the rôle of focal infection. Muscular rheumatism or myositis or neuromyositis is probably always due to infected tonsils or teeth. In discussing arthritis we must remember that there are many kinds of joint disease. There is inflammatory rheumatism, which causes so much heart trouble and which is usually attributed to tonsillar disease. There is gout,

which is not diagnosed as often as it should be. Then there are tuberculosis of the joints and syphilitic joint disease. Some pain in the joints is due to faulty metabolism, and some deformity may be due to senile changes. It is in the large group known as infectious arthritis that focal infection seems to be such a prominent factor; and here, unless we eradicate the focus early in the disease, we cannot hope for very favorable results. The teeth are often culpable in this type of arthritis. From these remarks it is evident that the diagnosis must be correct and the articular involvement not too well established if one is to hope for great improvement from eradication of foci.

When we consider the diseases of the bones, all we can say is that possibly osteomyelitis is due to infection by way of the blood stream from distant foci.

I know of no diseases of the ductless glands which can be said to be due to focal infection.

After all these things have been said about specific diseases in connection with focal infection, there remains a condition which cannot be called a disease and which is commonly seen by general practitioners. I refer to those patients who, previously vigorous and energetic, begin to complain of loss of pep, and examination of whom reveals no organic disease. In many of these, foci are found, and often removal of them results in a speedy return of the patient to his previous state of well-being. The physician cannot, however, promise patients of this class that such a procedure will solve the question of exhaustion, because often there are other essential factors, but he can explain the importance of it and the possibilities.

Summing all this up, there are many diseases in which focal infection plays an important rôle and in which eradication of all foci is a justifiable and scientific procedure. More justifiable and scientific than this, however, is the eradication of foci before infection of distant parts of the body has occurred. The physician is giving the patient who comes merely because of a general run-down condition or for a physical check-up the best advice when he directs him to take immediate care of all foci. This type of preventive medicine gives the best chance for long life.

Just how does the dentist fit into the scheme of modern medicine? As stated earlier, dentistry is really a specialty of medicine. While we expect our specialists to have a broad knowledge of general medicine, we do not expect them to be the judge of what is best for the patient when considered as a whole. The making of the diagnosis and the decision as to what should be done are the province of the internal medical man. He determines which specialists should be consulted and in a general way what they should do and what may be expected from cooperation with them. Just as we do not ask our medical specialists to assume charge of a case but merely to act as consultants in their special fields, so we do not ask our dental confreres to act as arbiters of the patient's health but to advise us what it is best to do with reference to the dental situation. The dentist cannot accept the responsibility of determining what is wrong with the patient as a complex organism, and he should not attempt to advise the patient what specialist of medicine he

should consult. If the patient has come directly to the dentist, and the latter learns that the patient is not well, or if there arises the quuestion of extraction of teeth, he should request the patient to consult a general medical man before he decides upon any drastic procedures himself. Sometimes the extraction of a single tooth will produce a severe flare-up of some infectious process smoldering in the patient, and if the patient should happen to have diabetes mellitus the extraction of a tooth may be sufficient to throw him into the serious state of diabetic acidosis or coma. Only by cooperation, therefore, between the dentist and the medical man can the medical sciences produce the greatest good for mankind.

HOSPITAL DENTISTRY*

By Harry M. Seldin, D.D.S., New York, N. Y.

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THE medical profession realizes the relation of oral sepsis to internal medicine. The internist realizes that gingivitis, periodontal infections, infections about unerupted and impacted teeth, and acute and chronic infections at the apices of the teeth can influence the rest of the body in either one of two ways.

One is by metastatic infection, bacteria going through the lymph channels into the blood and setting up a secondary or metastatic infection at some distant point.

The other way is by the absorption, not of the bacteria themselves, but of their toxic products, these products, after absorption, reaching distant parts of the body and injuring them.

The internist consulting the dentist expects him to be thoroughly conversant, not only with the physiology and pathology of the mouth but of the whole body. Unfortunately, too many of us are not so conversant. Many of us even have no conception of proper operating room procedures.

It is for this reason, I believe that one year of hospital internship should be part of the dental education; the same as it is in the curriculum in the study of medicine.

It should be clear that the prospective intern should be able to meet the standards usually set for medical interns: he should be a recent graduate, with a keen appreciation of the high professional character of dentistry, and probably one who looks forward to specializing in exodontia or oral surgery. A dental internship can be of incalculable value to a young man.

The interest and attention being at present focused on dental internships are in themselves symptomatic of a new spirit in dentistry. It is everywhere becoming recognized and acknowledged that the dentist is no longer treating a patient's teeth, but rather that he is treating a patient's *health* in so far as it is dependent upon and related to his teeth and associated structures. Both the medical and the dental professions are displaying increasing awareness of this situation, and I think that it is to the everlasting credit of the dental profession that it persists in trying to cooperate with and even, in a sense, to educate the medical profession despite indifference and even frequent rebuffs. It is evident that the dental intern is in a peculiarly advantageous position to

*Read before the District of Columbia Dental Society, February 25, 1930.

acquire the training that will enable him later to act as a liaison officer between the two professions. He has the opportunity to acquire familiarity with, on the one hand, the general systemic effects and aspects of oral diseases, and on the other, with many general diseases which have oral manifestations. A dentist who has had the training afforded by an internship would be eminently fitted to act as a consultant upon whom the general practitioners of both professions might call for guidance in difficult and unusual cases involving the mouth.

A brief outline of the training a dental intern may expect to receive would include the following:

He will acquire familiarity with the symptomatology, clinical importance, and bearing on resistance or tolerance to the strain incident to oral surgery of such general conditions as diabetes, abnormal blood pressure, cardiac and kidney diseases, endocrine disturbances, as goiter, Addison's disease, etc.

He will become skilled in physical diagnosis and will be able to judge the character of a patient as a surgical or anesthetic risk.

He will be at home in the operating room and will become familiar with the routine and the principles of general surgical and medical treatment.

He will be able to recognize and distinguish between the various anemias and leucemias, most of which have oral manifestations; indeed, in some of these, oral symptoms may predominate and appear before any others, as bleeding from the gums, gingivitis, etc. (Prinz says that Moeller's glossitis indicates a present or threatening pernicious anemia. Schroff ascribes it to gastric hyperacidity.)

The following is a concrete example of how a dental intern can not only aid the internist, but will actually diagnose cases that baffle him.

Mrs. X., married ten years, was admitted to the hospital on the point of starvation. History showed that she was in the sixth month of pregnancy. Wassermann test was negative. For the past six months she could not swallow a morsel of food without severe retching and vomiting. Vomitus was green in color. The result was obviously actual starvation. Many methods of feeding were resorted to but without result. Finally, the patient received rectal feeding, and she improved somewhat.

The cause of this intolerance to food, as advanced by the various physicians, was pregnancy and gastrointestinal infarct. The prognosis for both mother and fetus was bad.

In the routine examination by the physician the patient's gums were noted to be swollen, he called it Vincent's angina and prescribed sodium perborate. About a week later, the dental intern assigned to ward service noticed the patient's mouth, and by its typical grayish ulcers and characteristic odor immediately recognized it as mercurial stomatitis. This dental intern inquired into the patient's history. She had several teeth extracted twelve days before being admitted, because her gums and mouth were sore. Since Wassermann test was negative, and she had received no salvarsan treatment, the intern inquired if she was in the habit of taking laxatives. She then gave a history of being constipated for a number of years and was forced to take laxatives daily. She was taking a patent medicine (Calotab Pills) containing calomel for several years. She took about nine Calotabs each week, but since her pregnancy, she had to resort to larger quantities, taking nine Calotabs each night. For the last six weeks, she took 3 C. C. Pills daily in addition to the Calotab pills. Each C. C. Pill contains 1 gram of calomel. She built up a resistance to calomel in these years, otherwise she would not have tolerated those large doses. The result was mercurial poisoning. A 24-hour specimen of urine showed a large amount of mercury. She was immediately given retention enemas of magnesium sulphate,

also forced fluids. Quinine was prescribed to make her sweat, so that the mercury could be eliminated through the excretory channels of the body. Within a few days there was an amazing recovery. She was able to take and assimilate food and began to come back to her normal self.

The dental intern also will have the opportunity to learn and to apply clinical bacteriology.

He will receive training in oral surgery through acting as assistant to the attending dentist in all his operations at the hospital.

He will have the opportunity to engage in clinical research if he finds some problem of special interest.

Through frequent consultations with physicians on the staff, through attendance at staff meetings, through association with medical interns, he will acquire a point of view which will make it impossible for him ever to regard a patient only as a dental mechanism, as all too many dentists do today, rather than as a biologic entity.

In conclusion, it may be said that an internship and a hospital affiliation are invaluable opportunities for a young dentist to acquire a foundation in the medical aspects of dentistry, with considerable training in dental and oral surgery. Such knowledge and such a background are useful to a general practitioner who wants to give his patient intelligent and conscientious oral health service rather than fillings and bridges, but it is fast becoming indispensable to any young dentist who looks forward to specializing some day in exodontia or oral surgery.

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

Edited By
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X-RAY AND THE SINUSES*

By G. B. Trible, M.D., F.A.C.S., Washington, D. C.

THE unqualified diagnosis of sinusitis is as irrational with our present knowledge of pathology, as the diagnosis "fever" of our medical ancestors. It is Ballance who has stated somewhat in these terms, "That where there is a wide divergence of opinion regarding treatment, it is due to a misunderstanding of the pathology, for with a definite knowledge of the pathologic processes involved, treatment becomes stabilized and standardized." The tendency to stabilization and standardization of treatment is beginning to become apparent in the chaotic mass of sinus literature, and any diagnostic aid toward this end should be utilized. One of these aids, without which a thorough study cannot be made, is the use of the x-ray picture, especially associated with its adjunct, the use of the roentgen opaque solutions.

It is within the last ten years that I personally have seen the attempt at a frontal sinus operation abandoned because of the absence of a frontal on that side. Evidently the diagnosis had been made because of pain in the sinus area, which is decidedly different from disease of the sinus underlying that area; as a matter of fact, most of the pain from acute and subacute antrum involvements is frontal. The technic of development and the positions used in getting sinus plates that can be interpreted are the functions of the roentgenologist, but the ability to interpret and to practice the making of such interpretations and associating the results with the other symptoms and findings, so as to make a complete and harmonious picture, is in the scope of duties assumed by the surgeon, when he sets out to be an otolaryngologist.

USES OF THE X-RAY IN ANATOMY

The extent of development and the thoroughness of pneumatization can best be made out by the x-ray film. Anatomic variations, the presence of septa which would interfere with a normal course of drainage can be ascertained in this way more easily than in any other manner. Even the picture of septal deviations and turbinate impingements is seen in a larger way

*Read before the Washington Clinical Club, March, 1930.

than by specular examination. Its cousin, transillumination, fails us completely in the sphenoid and ethmoid sinuses, and in the case of darkness in the frontal area does not tell us whether it is due to lack of development or to pathologic changes. In its best field, the antrums, transillumination may divert our suspicion by extreme brilliance, which is really due to clear fluid, or cysts.

In establishing the relations of the teeth to the antrums, and their pathology, the x-ray picture cannot be supplanted.

The criticism that the x-ray film showed the sinuses cloudy, but on opening them there was no pathologic condition, is due to a superficiality that, it is hoped, no special surgeon would be guilty of today. The radiograph is a shadow not a photograph. It is based on relative density. An old inflammation leaving changes in the calcium content of the bones and periosteum often leaves a persistently denser shadow; a new one, yet in the acute inflammatory state, without such changes does not necessarily cast a shadow. The question

Fig. 1.—Left maxillary sinusitis in a child four years of age.

of contrast enters; according to dentists, teeth projecting even into the antrum, with no contrast, may show no pathologic condition and on extraction show granuloma. The use of the nasopharyngoscope enters here; study of the mucosa, of the presence of exuding secretion, polypi, degenerated mucosa, crusts, or painful areas, must be worked out.

With no free secretion, all quiet, but still darkened x-ray film, use of the instillation of radiopaque solutions and study of the lining membrane of those sinuses, especially in the antrums, are invaluable. If more than one-fourth inch thickness in the antrums, Faulkner says open.

Polypi, or granulation tissues may be disclosed, especially in the antrums, and the location of the filling defect will often give a clew to the type of infection, whether dental or nasal in origin. Particularly in cases of dental fistula is this method serviceable, as shown in Fig. 5.

Antral surgery and treatment are making great strides and are more

nearly stabilized than is surgery of the other sinuses. In a recent symposium on the maxillary sinuses read before the Academy of Medicine in New York, by the Section on Laryngology and Rhinology, there were very definite evidences of crystallization of surgical ideas along this line; as definite as could

Fig. 2.—Showing the usual position of the needle in maxillary sinus puncture.

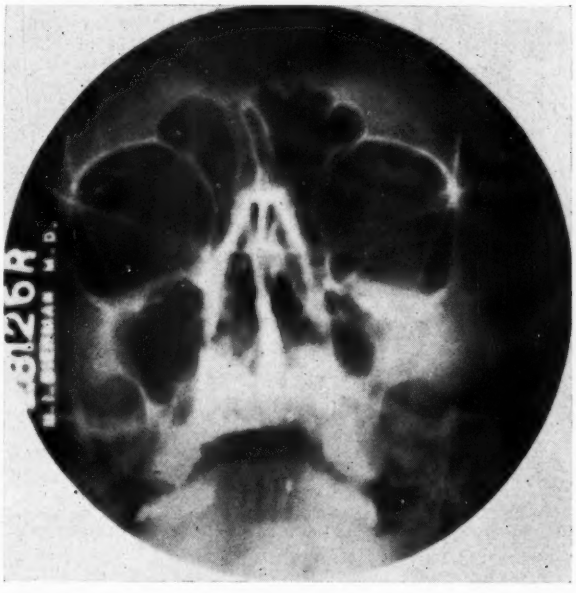

Fig. 3.—Infected left maxillary sinus showing a lighter area due to projection downward of an ethmoido-maxillary cell.

be expected in a cavity varying in its anatomic relationship as well as in its function in the different years of life, susceptible to infection from two great sources, as well as the unavoidable trauma, which may open it, essentially a nasal chamber, into the mouth, which has a widely different secretion and bacterial content.

It seems to be advocated rather definitely that there are first the two great divisions of treatment, surgical and nonsurgical, of which the nonsurgical has become practically stabilized in all sinus work and consists of shrinkage of the congested parts adjacent to the sinus ostia, with weak solutions of cocaine and ephedrine on pledgets of cotton, then gently irrigating with some mild, hot alkaline solution and then packing into the nose strips of gauze or

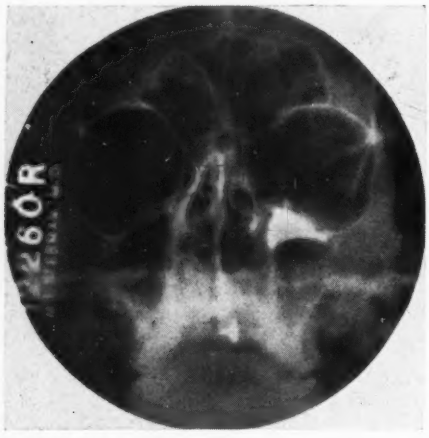

Fig. 4.—Lipiodol resting on top of a large cyst in the left maxillary sinus.

Fig. 5.—Funnel-shaped projection of lipiodol shadow to floor of antrum. Shape due to surrounding inflammatory tissue on floor. Injection through communicating tooth socket.

cotton saturated with one of the silver colloids, which are left in situ for one-half to four or five hours, depending upon the office routine.

The surgical treatment is in turn divided into 3 groups, or rather two groups, each subdivided but overlapping in one particular, that is, whether the infection is of oral or nasal origin, and then whether or not it is a condition which can be handled by simple surgery, such as opening and drainage, or whether more extensive surgery is indicated. The trend of opinion seemed to be that if three or four punctures do not show considerable relief, it was

best to make a small intranasal opening which would permit the introduction of a cannula and drainage and irrigation, then the divergence of opinion comes about as to whether there is any communication with the mouth or any infection in the mouth and teeth which could be communicated to the antrums. If the case presented elevations of the mucosa of more than one-fourth inch as shown by radiograph, or radiograph with roentgen opaque solutions, then the cavity must be opened sublabially and cleared out, and this is particularly true in the cases where there is an osteitis.

The relative proportion of sinus involvement has been fairly well worked out by the use of the x-ray pictures and has changed to no small extent our conception of the frequency of involvement of the various groups.

Bierman, working with our cases, in a thousand radiographs of the frontal, maxillary, and in a few of the sphenoid sinuses, of cases giving evidence of pathology justifying x-ray examination, finds:

		PER CENT
One maxillary sinus	330 cases	33.0
One maxillary and one frontal sinus	253 cases	25.3
One frontal sinus	163 cases	16.3
Two maxillary and one frontal sinus	88 cases	8.8
Two maxillary sinuses	75 cases	7.5
Sphenoid sinuses (usually in conjunction with other sinuses)	49 cases	4.9
Two maxillary and two frontal sinuses	21 cases	2.1
Pansinusitis	15 cases	1.5
Two frontal sinuses	6 cases	0.6
		100.0

In three hundred cases examined for the distribution of ethmoidal infections, we find the following:

Ethmoids (one side)	17%
Maxillary and ethmoids (one side)	26%
Frontal and ethmoids (one side)	14%
Frontal, maxillary and ethmoids (one side)	29%
Two maxillary sinuses and ethmoids one side	3%
Two maxillary sinuses and ethmoids (two sides)	11%

These figures are in substantial agreement with others along these lines and almost the same as our completed records of almost three thousand radiographs.

It has further taught us caution in intranasal work, has shown us cases relatively suitable anatomically and these so developed that intranasal operations would be not only unavailing but possibly highly dangerous.

ABSTRACT OF
CURRENT LITERATURE

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA
DENTAL RADIOGRAPHY
By Dr. Edward Preble, New York City

NUTRITION AND PEDIATRICS
By Samuel Adams Cohen, M.D., New Yerk City

It is the purpose of this Journal to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Orthodontia, Oral Surgery, Surgical Orthodontia and Dental Radiography

Dangers of Extraction in Acute Leucemia. Editorial, Dental Surgeon (British) **27**: 1332, 1930.

Acute leucemia, although rare, is more common than is often supposed. In some material the chief sufferers are infants and young adult males, while in others there is a preponderance of women between thirty and forty years. The prognosis is extremely grave, for two-thirds of the patients succumb within a few months. A condition of oral sepsis is very common which, although it cannot be accused of being a cause, must aggravate the condition. If the mouth is untreated, the last vestige of hope may be taken from the patient. But extraction, even of a single tooth, in these patients may end fatally; and while the editor gives no figures, he evidently regards this sequence as not uncommon. In any case if the basic blood state had gone unrecognized, the dentist would certainly proceed to extraction; and if it had been identified, he might still feel obliged to extract. In addition to fatal cases there are others in which grave symptoms followed extraction. If a large number of teeth are extracted in these cases, the risk is of course greater in proportion; hence, the dentist is placed in a quandary, although, as most of these patients are interned in hospital wards when seen, the responsibility can be put on the medical attendants. It is very difficult to lay down any definite rules of procedure, but certainly multiple extraction should be contraindicated. Aside from this, every case should be individualized, although it will often happen that a decision is practically impossible. As far as we know, the problem has not yet been submitted to a survey and statistical analysis, and this would appear to be the first requisite step.

Examination for Vital Teeth With the Arsonval Current. A. Borschke and H. Wolff (Vienna), Ztschr. f. Stomatol. **28**: 2, 1930.

This new method was first published about a year ago and in the meantime has been found to possess practical value. It is simple, dependable, and harmless. Naturally a discussion of the various apparatus would require too much space, and only a few of the basic requirements will be taken up. A single condenser vacuum electrode is used, and when the point touches a vital tooth, the patient experiences a definite sensation. The street current may be either direct or alternating with a voltage of 105 to 250, but the author prefers the former. The coil in use should have a scale of 5 current strengths, and the vital tooth often responds to strength 1 or 2. If there is no response, then one proceeds to use in succession strengths 3, 4, and 5. In the case of molars these higher strengths are usually required. If no response follows the application of strength 5, we may conclude that the pulp of the tooth in question is dead or badly damaged. In very timid or sensitive patients we should always begin with strength 1 and advance slowly to 2, as the scale is so devised that intermediate strengths are obtainable. The other teeth are protected from sparking by a rubber dam. The electrode is of the general shape of a writing pencil or pen and is to be held in the writing position. Apparently fillings and crowns do not interfere with carrying out the method. The electrode is self-isolating, but the operator wears a disk of gutta-percha to protect his hand from sparks, although these are neither dangerous nor painful. The apparatus comprises both a foot and a hand switch to aid in making the necessary contacts.

A Device for Aiding Cleft Palate. Editorial, Quart. J. Speech Educ. **16**: 1, 1930.

Two Viennese physicians, A. Schalit and E. Froeschl, presented before the Vienna Medical Society a device for aiding the speech of sufferers from cleft palate. The demonstration included a dialogue between one of these and a normal subject, and the attending medical men were unable to distinguish between them as far as the palate was concerned. The device had been planned on theoretic grounds which sought to explain the speech troubles of cleft palate. The latter is common—one in a thousand population—and while operative technic of closure of the cleft has been highly developed, the speech trouble is not correspondingly improved. In addition very many are not operated upon at all but make some use of prosthetic devices, although these have failed to give normal speech. The theory thus far has been very simple, blaming speech defects on the palatal fissure; but the authors have attributed it to the fissure higher up in the nose, which gives origin to a peculiar resonance. No attempt was made to close the palatal fissure, either by surgery or prosthetic apparatus, but a wedge was inserted into the nasal cavity which incidentally shut off from it the buccal cavity. Accessory parts of apparatus were added to complete the device.

Changes in Blood Sedimentation Index in Apical Infection. C. V. Rault (Washington), Dental Cosmos **72**: 3, 1930.

Blood sedimentation tests have now been in general diagnostic use for some years, having first been applied to pregnancy in 1918. In infections of any kind the red blood cells fall earlier than in the normal subject. As far as known the test has not been applied to dental infections and should be of value especially in supposed infection at the roots of the teeth. The author obtained the blood in the usual manner by puncturing the cubital vein, and 4½ cm. of blood are added to a 3 per cent sodium citrate solution to prevent coagulation. The number of people examined was 300, all males (the author is a member of the Dental Corps of the U. S.Navy). These were taken as they came, and all were first subjected to x-ray examination. In many of those examined the roentgen examination was negative. It must be borne in mind that every one of the men had passed a rigid physical examination. The author arrives at no mass result and lays down no generalizations. In one small series of 20 men between nineteen and twenty-five years old, fifteen gave negative x-ray findings, while in five others there were pulpless teeth and rarefied areas about the apex. Two sedimentation tests were made one week apart, and in the interval the offending teeth were removed. In theory the rate should have been rapid before removal and should have shown change for the better after extraction. In practice such results were not obtained. Those with infected teeth showed both very high and very low indices, and extraction was or was not followed by a change in the index, which in no case was marked. Therefore, it would appear that these men were not in a state of infection, or at least not necessarily. The negative findings could be construed as an argument against the doctrine of focal infection, and at least they fail to uphold it.

Nutrition and Pediatrics

Pooled Adult Blood Serum as a Prophylactic Measure in a Measles Epidemic in an Institution. Alvin E. Siegel and Hortense Ermann. Am. J. M. Sc. **179**: 2, 1930.

In children under one year of age measles produces a high mortality, and when it occurs in children over one year of age, many complications and sequelae arise. Moreover, Siegel and Ermann feel that measles should be held in higher regard and is deserving of much more attention from the point of view of its prevention. As yet, the specific infecting agent has not been correctly demonstrated.

At present the widely used method for passive immunization of measles is measles convalescent serum, which is procured from patients within ten days after defervescence of the disease.

In March and April, 1928, an epidemic of measles broke out among children in an institution in Philadelphia, and these investigators report on their attempt to prevent the spread of measles to 55 susceptible children who were

exposed to this disease. These children were inoculated with 5 c.c. of pooled (Wassermann negative) adult blood serum, with the remarkable result that no cases of measles occurred among these children. The authors, furthermore, say that the "blood (whole and serum) of convalescent patients, however, contains specific antibodies, since its injection has given uniformly good results either entirely preventing the disease, or producing an aborted or attenuated form, which nevertheless produced a lasting immunity."

Scarlet Fever. Gladys Dick, M.D. Illinois M. J. **57**: 1, 1930.

This authority on scarlet fever tells of her extensive experience with this disease. Six years ago she reported the fact that a specific type of hemolytic streptococcus was the causative agent of scarlet fever, and it was soon discovered that this organism was able to produce a potent soluble toxin. Moreover, experimental evidence in humans and animals indicates that recovery from the disease depends upon the production of an antitoxin which is capable of neutralizing the scarlet fever toxin in vitro.

Scarlet fever toxin and the corresponding antitoxin have been used as a means to determine the susceptibility to scarlet fever, identifying scarlet fever, its treatment and immunization of susceptible persons to scarlet fever. Dr. Dick reports on her six years of observations of a series of 32,440 persons on whom skin tests were made, of 11,584 susceptible persons who were immunized against scarlet fever, and of groups of susceptible individuals who were given prophylactic doses of antitoxin. Her results of 23,013 negative skin tests indicating immunity to scarlet fever were further substantiated by the evidence that, with one exception, none of these individuals contracted the disease even though many of them, for example interns and nurses, had prolonged exposure. She feels that other observers do not obtain her excellent results because of their inaccurate technic and faulty interpretation of the test.

In all, 12,775 susceptible persons were given graduated doses of sterile scarlet fever toxin with no injury noted in any instance. She says, however, that reactions may be expected in about 10 per cent of the cases after each dose. About 95 per cent of susceptible persons are said to be immunized completely after five full doses are injected subcutaneously at intervals of one week. Immunization, however, must be carried to a point of a negative skin test.

In the treatment of the disease Dr. Dick says that given early in adequate dosage, scarlet fever antitoxin gives brilliant results. On commenting on the conflicting reports on the use of this therapeutic measure, she states that frequently this is due either to a poor preparation of scarlet fever antitoxin, or to a delay in its administration.

Antiscarlatinal Inoculation in Poland. F. Redlich. Seuchenbekämpfung **6**: 4, 1929.

The author, writing from the Children's Clinic of the University of Lemberg, tells of his extensive experience in Poland with scarlet fever. Among other conclusions he says that he is not convinced of the reliability of the

Dick reaction to indicate the individual immunity to scarlet fever, or to the value of active immunization to protect against scarlet fever.

From his experience, no definite conclusion could be drawn concerning the treatment with specific antitoxin, but he feels that for the present, at least, this form of treatment may be considered optional.

The Value of Vaccine in the Prevention of Whooping Cough. R. P. Schowalter. Am. J. Dis. Child. **39**: 3, 1930.

The author quotes from the experience of many observers abroad and in this country in regard to the prophylactic value of pertussis vaccine, but the evidence is inconclusive as to its efficacy.

In regard to his own observations he reports on the statistical study of over 2,700 children who received prophylactic injections of pertussis vaccine during the past eight years at the Milwaukee County Home for Dependent Children. All children under six years of age entering the institution received these injections. As a control Schowalter used the morbidity rate of the institution during the eight-year period previous to 1921 when no vaccine was given. The statistics of the morbidity and mortality of pertussis in the city of Milwaukee were also used as a further means of control.

His figures show that pertussis vaccine had little or no value as a prophylactic measure against whooping cough.

The Period of Infectivity and Serum Prevention of Chickenpox. J. E. Gordon and F. M. Meader. J. A. M. A. **93**: 26, 1929.

Chickenpox ranks with measles as one of the most readily communicable of infectious diseases, and these investigators have been able to collect a number of instances at the Herman Kiefer Hospital at Detroit in which children who had been under strict isolation for twenty-one days previous to exposure to chickenpox subsequently contracted secondary varicella. From their observations they found that chickenpox lesions appeared from thirteen to seventeen days after exposure. They further say that preceding the eruption, chickenpox is apparently infectious for only a brief period, probably for not more than twenty-four hours. Moreover, this infectivity during convalescence is less prolonged than commonly considered, and does not necessarily coincide with the persistence of crusts. It probably lasts only ten days.

In discussing the serum prevention of chickenpox Gordon and Meader have found that convalescent serum furnishes a high degree of protection if the blood is obtained within one month of the appearance of the eruption. Obtained thereafter it is less efficient, and after five months confers protection on only a third of the immunized susceptible patients.

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EDITORIALS

Twenty-Ninth Annual Meeting of the American Society of Orthodontists

The twenty-ninth annual meeting of the American Society of Orthodontists was held at the Noel Hotel, Nashville, Tennessee, April 8, 9, 10 and 11, 1930.

The meeting was called to order on Tuesday morning by the President, Dr. Oren A. Oliver. The principal paper on Tuesday morning was given by Professor R. C. Brumfield, New York City, on "Structural Features Related to Orthodontic Materials and Appliances." This paper was the result of research work conducted by Professor Brumfield. On Tuesday afternoon Dr. Hellman, New York City, gave a paper on "Diagnosis and Treatment of Distoclusion." This was a masterful presentation and brought forth considerable discussion. The rest of the program on Tuesday was carried out according to schedule.

On Wednesday morning Dr. George B. Winter, St. Louis, gave a paper on "Impacted Mandibular Third Molars." This was followed by a paper on "Ethics" by Dr. W. A. Bryan, Nashville. The morning session closed with case reports by Dr. B. G. deVries, Minneapolis, and Dr. W. W. Woodbury, Halifax. On Wednesday afternoon Dr. F. M. Casto, Cleveland, gave a paper on "The Trend of Orthodontic Treatment." Case reports by Dr. W. R. Humphrey, Denver, and Dr. H. C. Pollock, St. Louis, followed.

Mr. Cale Matthews of Birmingham, England, was introduced to the Society by the President on Wednesday afternoon. He made a few remarks on the organization of the Second International Orthodontic Congress in Paris. Dr. Fisher then made a report in which he referred to the plan of organization that would be followed with such societies as affiliated themselves with the Second International Orthodontic Congress. A motion was then made that the American Society of Orthodontists join the Second International Orthodontic Congress as a body and instruct the Secretary-Treasurer of the American Society of Orthodontists to pay $10 to the Second International Orthodontic Congress for each member of the American Society who does not join the International Congress through some component Society. This motion was based on the fact that the New York Society of Orthodontists had already voted to pay $10 to the Second International Congress for each of their members in good standing in 1931. This motion was passed with very little discussion.

It was also voted that the time and place of the next meeting of the American Society of Orthodontists should be left in the hands of the Executive Committee of the American Society of Orthodontists. This motion was also passed, although it was contrary to the by-laws of the American Society of Orthodontists. Both these motions were brought up for reconsideration at a later meeting of the Society because a great many of the members were not satisfied with the action that had been taken. When the motion to leave the time and place of the next meeting of the American Society of Orthodontists to the Executive Committee was reconsidered, it was voted down. Another motion was then made that the next meeting be held in St. Louis, April 22, 23, 24 and 25, 1931. This motion was passed. The motion regarding the Second International Orthodontic Congress was then reconsidered because many of the members believed that the funds of the American Society of Orthodontists did not justify such an expenditure of money as had been voted previously. After the regular procedure was undergone in removing the original motion, it was moved and seconded that the American Society join the International Congress as a component society, which involves a payment of $10 and a sum of $1000 to be contributed to the Second International Orthodontic Congress. Also, it was the desire of the Society that the members take out individual membership in the International Congress. This motion was adopted. This plan will undoubtedly give the Second International Congress more funds than the previous one, and the American Society will not be taxed so much.

In the nomination of officers, Dr. W. E. Flesher, Oklahoma City, was nominated for president-elect, Dr. Claude R. Wood, Knoxville, Tenn., for secretary-

treasurer, Dr. Carl Mott, North Carolina, as a member of the Board of Censors and Dr. A. Hoffman, Chicago, as librarian.

The program for Thursday morning consisted of a paper on "Nutrition and Growth" by Dr. L. B. Mendel, Connecticut. The paper was discussed by Dr. E. H. Hatton, Chicago. This paper consumed practically the entire morning. "A Discussion of Infraversion and Supraversion" by Dr. C. C. Howard, Georgia, was on the program for Thursday but had been given at a previous session. Dr. Eby's paper on "Some Points in the Treatment of Distoclusion" was postponed and given at a later session. Thursday afternoon was given over to clinics, which proved very interesting.

On Friday morning Dr. T. Wingate Todd, Cleveland, gave a paper on "Further Development of the Dental Arches." This paper was very nicely presented by Dr. Todd, although it seemed to us that some of the statements which he made regarding cranial and facial development could have been developed in a manner more in keeping with clinical evidence. Unfortunately, owing to ill health, Dr. A. P. Rogers, Boston, could not present his paper on "Diagnosis and Treatment of Mesioclusion." A case report on "Treatment of Adult Open-Bite Cases by Grinding Occlusal Surfaces of Posterior Teeth" by Dr. Pullen, Buffalo, had been presented previously. On Friday afternoon, Dr. J. W. Maller, New York City, gave a case report on "A Simplified Photographic Technic for Determining the Relationship of the Teeth to the Face and Cranium in Living Subjects." This was followed by a paper on "Diagnosis and Treatment of Neutroclusion" by Martin Dewey.

The following men were installed for office for the ensuing year. Dr. H. E. Kelsey, Baltimore, President; Dr. C. R. Baker, Evanston, Ill., President-Elect; Dr. Claude R. Wood, Knoxville, Secretary-Treasurer; and Dr. W. A. Murray, Evanston, as member on the Board of Censors.

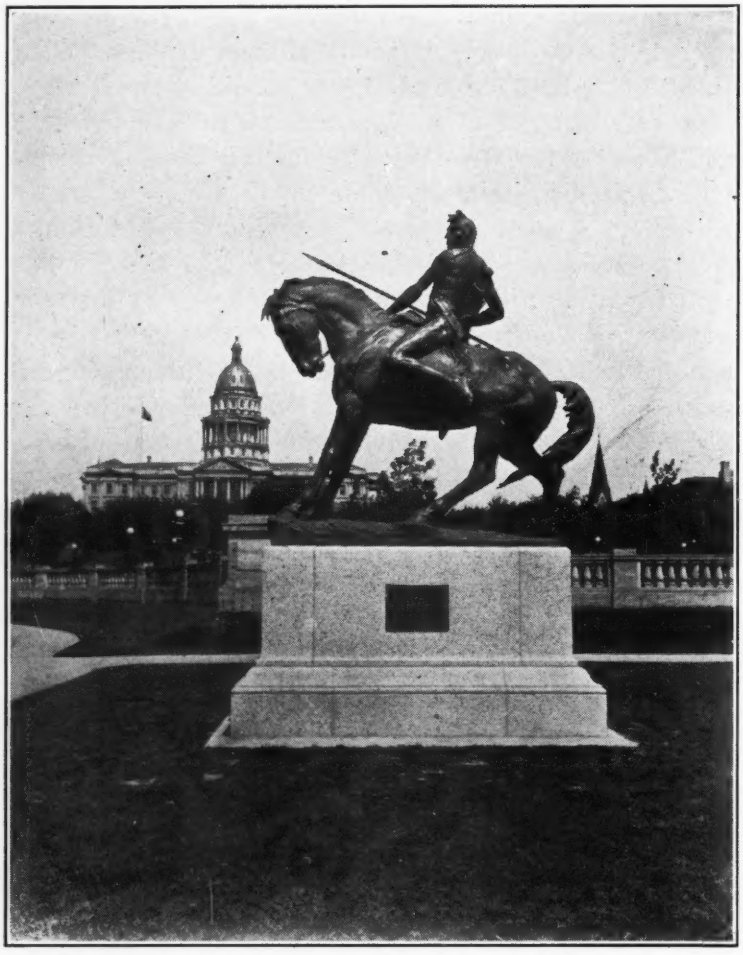
The twenty-ninth meeting of the American Society of Orthodontists at Nashville had a larger registration, a greater number of men admitted as members and more applications for membership than any previous meeting. It is hoped that every member of the American Society of Orthodontists will be able to attend the meeting in St. Louis in April, 1931.

NEWS AND NOTES

Denver, the Gateway to the West

A pioneer city which is modern in every respect is the scene this year for the seventy-second annual convention of the American Dental Association.

When the convention meets in Denver July 21, the visitors will see a thriving city of 320,000 inhabitants where seventy years ago there were a few scattered log cabins housing the first adventurous gold seekers.



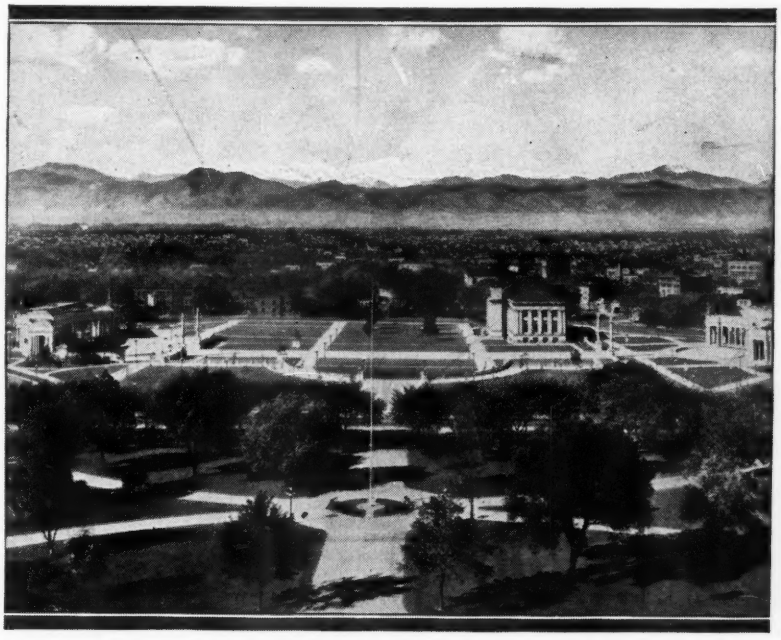
Indian monument with Capitol in the background, Denver, Colo.

Denver has been pronounced notably American, with a beauty and a spirit which make it distinctive from other cities of the world.

Both the city and the state have a romantic historical background bequeathed from pioneer times. The state was once a favorite foregathering place for the old mountain men, such as Sublette, Carson, Bridger and others. Remnants of these days, as well as of the gold rush period which followed, are preserved in a most interesting collection housed

in the Colorado State Historical Society Museum. Here also is one of the most complete collections of anthropologic material unearthed in the cliff dwellings of southwestern Colorado. These include not only the artifacts, tools, pottery and cloth of this most interesting people but a large collection of skulls and skeletons of this ancient race.

The beauty of Denver is enhanced by a fine system of charmingly landscaped parks and spacious, tree-lined boulevards. Three municipal golf courses are maintained in the



Civic Center, Denver, Colo.

city, and a fourth, unique of its kind, thirty miles out, is in Denver's Mountain Park system.

Come up to Colorado for the *mile high convention.* This will be the busy season of the year, so make your reservations early. For hotel and travel information write: Local Committee, A.D.A., 1222 Republic Building, Denver.

Greater New York December Meeting for Better Dentistry

The Sixth Greater New York December Meeting for Better Dentistry will be held at the Hotel Pennsylvania, New York City, December 1-5, 1930.

The Committee is preparing a program which will be both interesting and of high scientific value. Essays and clinics will be held and progressive teaching clinics along various lines will be an important feature. The topic discussions will again occupy an important place in the program.

A Manufacturers' Exhibit will be held in the Hotel simultaneously with this meeting.

JOHN T. HANKS, Chairman.
CHARLES M. MCNEELY, Vice-Chairman.

The American Board of Orthodontia

A meeting of the American Board of Orthodontia will be held in Denver following the American Dental Association meeting in July.

Those orthodontists who desire to qualify for a certificate from the Board as outlined

in the article entitled, "The American Board of Orthodontia," page 50, January issue of the INTERNATIONAL JOURNAL OF ORTHODONTIA, ORAL SURGERY AND RADIOGRAPHY, may receive full information and application form from the secretary of the Board.

DR. ALBERT H. KETCHAM, President,
1232 Republic Building,
Denver, Colorado.
DR. OREN A. OLIVER, Secretary,
1101 Medical Arts Building,
Nashville, Tennessee.

Second International Orthodontic Congress

The Second International Orthodontic Congress will be held in London in 1931 at the Hotel Great Central from July 20 to 24 inclusive.

The officers of the Congress will be as follows:

President-General	J. H. Badcock
Vice-President-General	G. Northcroft
Treasurer-General	E. D. Barrows
Secretaries-General	A. C. Lockett
	B. M. Stephens

A list of honorary presidents and vice-presidents will be communicated later.

A full and interesting program of papers and demonstrations is anticipated, and a museum is being organized. Suitable entertainment for ladies accompanying members will be arranged. Intending contributors to the activities of the Congress can obtain from the Secretaries of their respective orthodontic (or dental) societies the conditions under which contributions are invited. The Secretary-General (Mr. A. C. Lockett, 75 Grosvenor Street, London, W. 1) will also be glad to give any further information on request.

Information regarding travelling facilities and hotel accommodation may be obtained from the official agents to the Congress, Messrs. Morgan Pope & Co., of 7 St. James's Street, London, S. W. 1; 6 Rue Caumartin, Paris; 71 Vanderbilt Avenue, New York; Messrs. Noel Vester & Co. (agents), 44 Unter den Linden, Berlin.

Italian Stomatologic Congress

In 1930 under the auspices of the Federazione Stomatologica Italiana, the Italian Stomatologic Congress will be held in Venice, Italy. Delegates from sixteen countries will attend. For information, address Prof. Dr. U. Saraval, Piazza S. Marco, Venice, Italy.

Notes of Interest

Dr. Donald Hutchinson announces the removal of his New York office to 400 Madison Avenue, New York, N. Y. Practice limited to orthodontia.

Mr. Harold Champman announces the removal of his office to 6 Upper Wimpole Street, W. 1, London, England, for the practice of orthodontics exclusively.

Dr. Herbert V. Muehnic, formerly associated with Dr. Alfred Friedman, announces that he will continue in the practice of orthodontia, 906 W. P. Story Building, Los Angles, Calif.

Dr. Samuel Schnaper announces that Dr. Morton Maier is now associated with him in the practice of dentistry, 2 East 54th Street, New York, N. Y.

Dr. Kirman E. Taylor announces that he will continue the orthodontia practice of Dr. Harry W. Wilson at 1110 Republic Building, Denver, Colo.

Dr. Irving Rosenwasser announces the opening of this office at 1 Hanson Place, Brooklyn, N. Y. Practice limited to orthodontia.

Dr. Archie B. Brusse announces that Dr. J. Lyndon Carman has been associated with him in the exclusive practice of orthodontia for the past year in the Republic Building, Denver, Colo.